United States
Environmental Protection
Agency

Office of Solid Waste
Washington DC 20460

SW 3004
1978

Solid Waste

EPA

Resource Recovery Technology

An Implementation Seminar Workbook

RESOURCE RECOVERY TECHNOLOGY

An Implementation Seminar Workbook

U.S. ENVIRONMENTAL PROTECTION AGENCY

Revised Edition, 1978

This workbook (SW-3004) contains copies of some of the slides presented by the Resource Recovery Division of the Office of Solid Waste at its seminars.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF WATER AND HAZARDOUS MATERIALS

Welcome . . .

to this resource recovery seminar presented by the Office of Solid Waste of the United States Environmental Protection Agency.

The purpose of the seminar is to provide an overview of the status of resource recovery and a discussion of implementation procedures. We believe that this information can be particularly helpful to municipal and State agencies that are considering implementation of resource recovery. We view this activity as augmenting the in-depth technical assistance which is to be provided through the Resource Conservation Panels program mandated by the recently enacted Resource Conservation and Recovery Act.

In utilizing our own staff for presentation of this seminar, we in no way presume to be the foremost expert on each of the subjects presented. However, based on our tracking of nationwide activities in resource recovery, our experience in providing technical assistance, and our involvement in demonstration and evaluation projects, we hope to be able to provide a unique "third-party" perspective to this subject. We will endeavor to be fair and even-handed, yet honest and objective in the process.

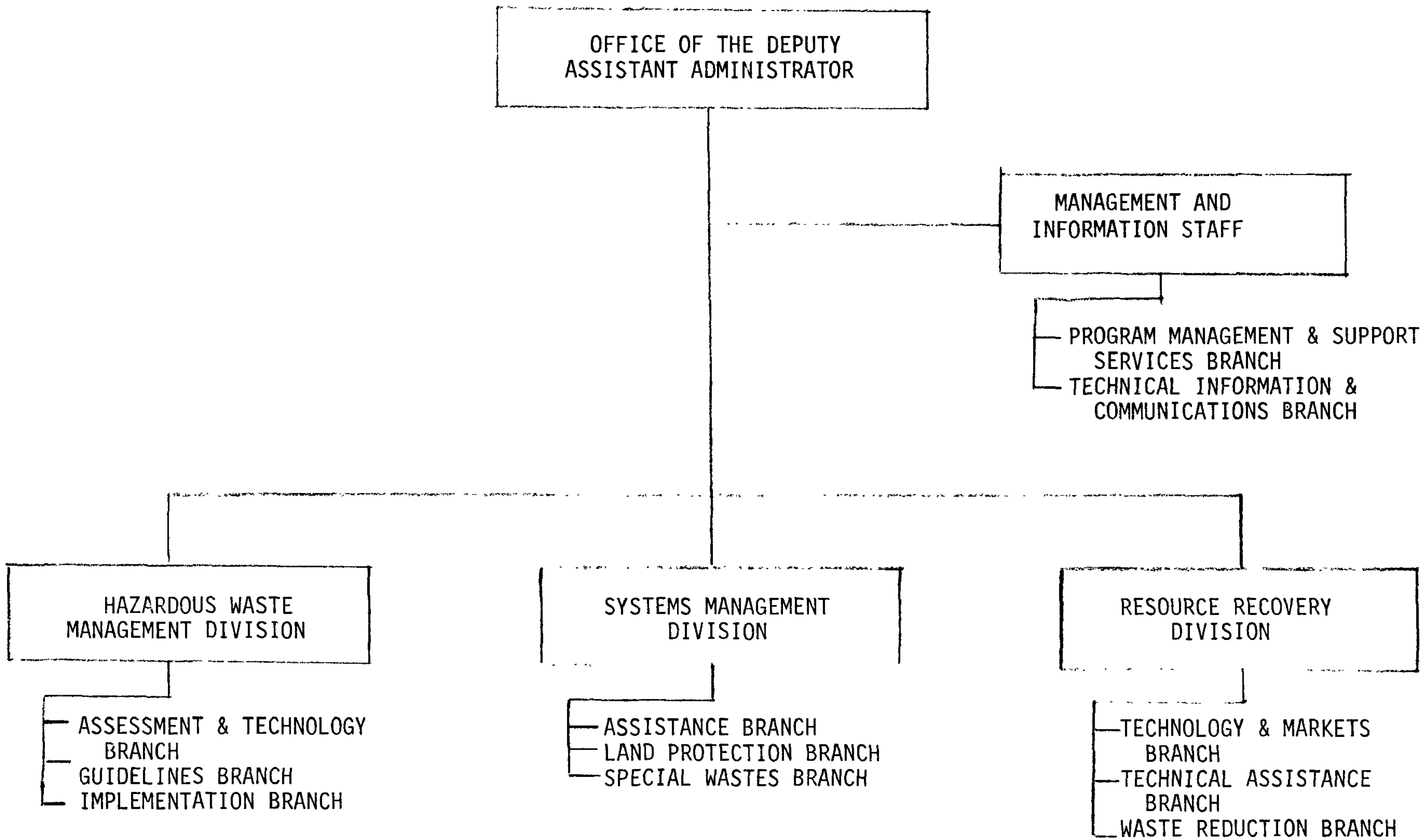
In an attempt to make available a wide range of information, we have included references to technical reports to supplement the information which will be presented at the seminar. In addition, we have provided each registrant with a package of publications which includes an eight-part EPA publication series called: Resource Recovery Implementation: A Guide for Municipal Officials.

This is one in a series of regional seminars, and will be presented to State and local governments on a more individual basis if requested.

We thank you for your attendance and hope that this will be an informative and productive experience for both you and EPA.

Steffen W. Plehn
Deputy Assistant Administrator
for Solid Waste

OFFICE OF SOLID WASTE MANAGEMENT PROGRAMS



LIST OF EPA

REGIONAL CONTACTS

I. Dennis Huebner
Solid Waste Program
John F. Kennedy Bldg.
Boston, MA 02203
(617) 223-5775

II. Michael F. Debonis
Solid Waste Branch
26 Federal Plaza
New York, NY 10007
(212) 264-0503/4/5

III. C. Howard/Wm. Schremp
Solid Waste Program
6th & Walnut Streets
Philadelphia, PA 19106
(215) 597-8116

IV. James Scarbrough
Solid Waste Section
345 Courtland St., N.E.
Atlanta, GA 30308
(404) 881-3116

V. Karl J. Klepitsch, Jr.
Solid Waste Program
230 South Dearborn St.
Chicago, IL 60604
(312) 353-2197

VI. Richard O. Amber
Solid Waste Program
1201 Elm Street
First Intl. Bldg.
Dallas, Texas 75270
(214) 767-2734

VII. Morris G. Tucker
Solid Waste Section
1735 Baltimore Ave.
Kansas City, MO 64108
(816) 374-3307

VIII. Lawrence P. Gazda
Solid Waste Branch
1860 Lincoln Street
Denver, CO 80203
(303) 837-2221

IX. Charles Bourns
Solid Waste Program
215 Freemont Street
San Francisco, CA 94105
(415) 556-4606/7/8

X. Tobias A. Hegdahl
Solid Waste Program
1200 6th Avenue
Seattle, WA 98101
(206) 442-1260

RESOURCE RECOVERY TECHNOLOGY

AN IMPLEMENTATION SEMINAR

AGENDA

DAY 1

TIME	TOPIC
8:00-9:00 am	REGISTRATION
9:00-9:15 am	INTRODUCTION AND STATUS OF IMPLEMENTATIONS
9:15-9:45 am	IMPLEMENTATION APPROACH
9:45-10:45 am	MARKETS
10:45-11:00 am	COFFEE BREAK
11:00-12:15 pm	SOURCE SEPARATION
12:15-1:30 pm	LUNCHEON
1:30-2:00 pm	COMPATIBILITY
2:00-3:00 pm	MECHANICAL PROCESSING
3:00-3:15 pm	COFFEE BREAK
3:15-4:30 pm	DIRECT COMBUSTION

DAY 2

TIME	TOPIC
8:30-9:45 am	REFUSE-DERIVED FUEL
9:45-10:00 am	COFFEE BREAK
10:00-10:45 am	PYROLYSIS
10:45-11:30 am	CO-DISPOSAL
11:30-12:00 pm	METHANE RECOVERY
12:00-1:30 pm	LUNCHEON
1:30-2:15 pm	INDUSTRIAL WASTE EXCHANGE AND WASTE OIL RECOVERY
2:15-2:45 pm	HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATIONS
2:45-3:00 pm	COFFEE BREAK
3:00-3:30 pm	ECONOMIC CONSIDERATIONS
3:30-4:30 pm	CONTRACTS, RISKS AND FINANCING

TABLE OF CONTENTS

MARGIN INDEX - To use, bend book in half and follow margin index to the page with black-edge marker.

Introduction and Status of Implementations

INTRODUCTION

I. SEMINAR OBJECTIVES

   A. Purpose

   B. Who is it for?

II. SEMINAR MATERIALS AND ORGANIZATIONS

   A. Workbook

   B. Publications

   C. Plan for presentations

   D. Schedule

III. BACKGROUND

   A. RCRA mandates

   B. Activities of Resource Recovery Division

   C. Driving forces

IV. CURRENT STATUS

   A. Source separation

   B. Mechanical systems

SUMMARY OF RESOURCE RECOVERY MIXED WASTE FACILITIES IMPLEMENTATION

March 1978

Location	Type*	Capacity (TPD)	Products/Markets	Start-up Date
SYSTEMS IN OPERATION:				
Altoona, Pennsylvania	Compost	200	Humus	1963
Ames, Iowa	RDF	400	RDF-Utility, Fe, Al	1975
Baltimore, Maryland (D)	Pyrolysis	700	Steam Heating & Cooling, Fe	1975
Baltimore County, Maryland (D)	RDF	550	RDF, Fe, Al, Glass	1976
Blytheville, Arkansas	MCU	50	Steam Process	1975
Braintree, Massachusetts	WWC	240	Steam Process	1971
E. Bridgewater, Massachusetts (D)	RDF	160	RDF-Utility	1974
Franklin, Ohio (D)	Wet Pulp	150	Fiber, Fe, Glass, Al	1971
Groveton, New Hampshire	MCU	30	Steam Process	1975
Milwaukee, Wisconsin	RDF	1000	RDF-Utility, Paper Fe, Al	2/77
Nashville, Tennessee	WWC	720	Steam Heating & Colling	1974
Norfolk, Virginia	WWC	360	Steam-Navy Base	1967
Oceanside, New York	RWI/WWC	750	Steam	1965/74
Palos Verdes, California	Methane Recovery		Gas Utility & Fe	1975
Saugus, Massachusetts	WWC	1200	Steam Process	1976
Siloam Springs, Arkansas	MCU	20	Steam Process	1975
South Charleston, West Virginia (D)	Pyrolysis	200	Gas, Fe	1974

*RDF=Refuse-derived Fuel; WWC=Waterwall Combustion; RWI=Refractory Wall Incinerator with Waste Heat Boiler; MCU=Modular Combustion Unit; D=Pilot or Demonstration Facility.

SUMMARY OF RESOURCE RECOVERY MIXED WASTE FACILITIES IMPLEMENTATION

March 1978

Location	Type*	Capacity (TPD)	Products/Markets	Complete Construction
SYSTEMS UNDER CONSTRUCTION OR IN STARTUP:				
Akron, Ohio	RDF/WWC	1000	Steam Heating & Cooling	7/78
Bridgeport, Connecticut	RDF	1800	RDF-Utility, Fe, Al, Glass	6/78
Chicago, Illinois (Crawford)	RDF	1000	RDF-Utility, Fe	11/76
Hempstead, New York	Wet Pulp/WWC	2000	Electricity, Fe, Al, Glass	9/78
Lane County, Oregon	RDF/WWC	750	RDF-Institution, Fe	3/78
Monroe County, New York	RDF	2000	RDF-Utility, Fe, Al, Glass	9/78
Mountain View, California (D)	Methane Recovery		Gas-Utility	6/77
New Orleans, Louisiana (D)	Materials	650	Nonferrous, Fe, Glass, Paper	6/78
Nigara Falls, New York	RDF/WWC	2200	Steam-Industry, Fe	-
Portsmouth, Virginia (shipyard)	WWC	160	Steam Loop	12/76
San Diego, California (D)	Pyrolysis	200	Liquid Fuel-Utility, Fe, Al, Glass	4/77

*RDF=Refuse-derived Fuel; WWC=Waterwall Combustion; RWI=Refractory Wall Incinerator with Waste Heat Boiler; MCU=Modular Combustion Unit; RDF/WWC=Waterwall Combustion using processed waste; D=Pilot or Demonstration Facility.

Implementation Approach

IMPLEMENTATION APPROACH

I. PRIMARY FACTORS

A. Markets

B. Waste supply

C. Technologies

D. Procurement strategy

E. Performance requirements

II. ALTERNATIVE APPROACHES

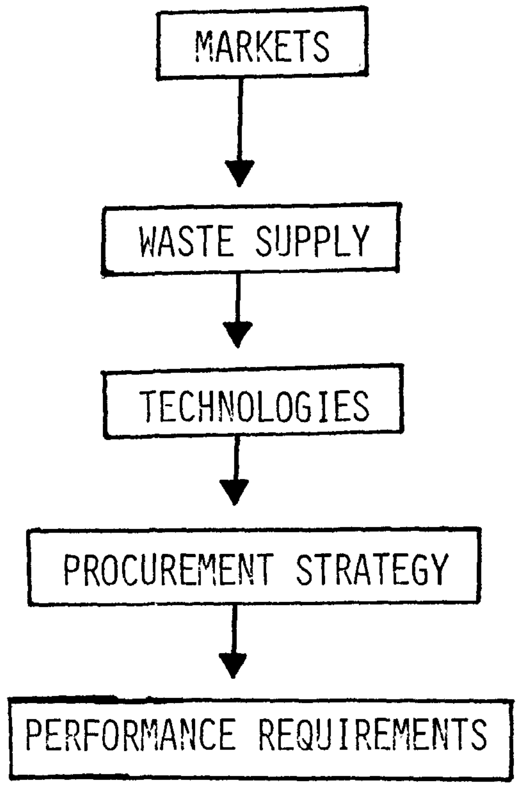
A. Procurement

B. Financing

III. ISSUES

A. Compatibility

B. Citizen acceptance


MARKETS
WASTE SUPPLY
TECHNOLOGIES
PROCUREMENT STRATEGY
PERFORMANCE REQUIREMENTS

The Implementation Process

Planning → Procurement → Construct

Planning

Key Decisions

- Waste Control
- Markets
- Siting
- Technology
- Procurement
  - Ownership
  - Operation
  - Risk Posture
  - Financing

Procurement

Key Actions

- RFP Prep.
- Selection
- Negotiation

or

- Select A&E

Construct

Key Actions

- Obtain Financing
- Design
- Construct
- Shakedown

Markets

MARKETS

I. INTRODUCTION

A. "Markets first"

B. Wasteville, USA

II. MARKETING TECHNIQUES

A. Three marketing steps

1. Identification

2. Preliminary commitment

3. Contract

B. Waste composition defines potential products

III. ENERGY PRODUCTS FROM SOLID WASTE

A. Energy products recovered from a ton of solid waste

B. Potential buyers

C. RDF

1. Capacities of potential users

2. Are electric utilities a viable market?

3. Experience in marketing

D. Steam

1. Considerations in marketing

2. Experience in marketing

E. Electricity

1. Considerations in marketing
2. Experience in marketing

F. Gas and oil

1. Considerations in marketing
2. Experience in marketing

IV. MATERIAL PRODUCTS FROM SOLID WASTE

A. Ferrous metals

1. Alternative users/values
2. Buyer requirements

B. Nonferrous metals

1. Aluminum users/values
2. Mixed nonferrous users/values

C. Glass

1. Use/value as cullet
2. Use/value as aggregate

D. Paper

1. Matching of users and grades
2. Values

MARKET IDENTIFICATION

TASK

IDENTIFY POTENTIAL USERS AND INITIATE DISCUSSION.

OUTPUTS

DATA ON:

- PROMISING BUYERS
- QUANTITIES SALABLE
- GENERAL QUALITY REQUIREMENTS
- APPROXIMATE VALVES

REMINDERS

- USE APPROPRIATE EXPERTISE
- KNOW WASTE STREAM AND RECOVERY POTENTIALS
- BE THOROUGH
- UNDERSTAND USER NEEDS
- BE AWARE OF LEGAL OBSTACLES

PRELIMINARY COMMITMENT

TASK

NEGOTIATE SPECIFICS; OBTAIN COMMITMENTS

OUTPUTS

LETTER OF INTENT

MEMORANDUM OF UNDERSTANDING

REMINDERS

- UNDERSTAND PRICING
- CAN SPECIFICATIONS BE MET?
- COMPLETE BEFORE FINAL TECHNOLOGY SELECTION

FORMAL CONTRACT

TASK

OBTAIN COMPETITIVE BIDS;
DEVELOP CONTRACT DOCUMENTS

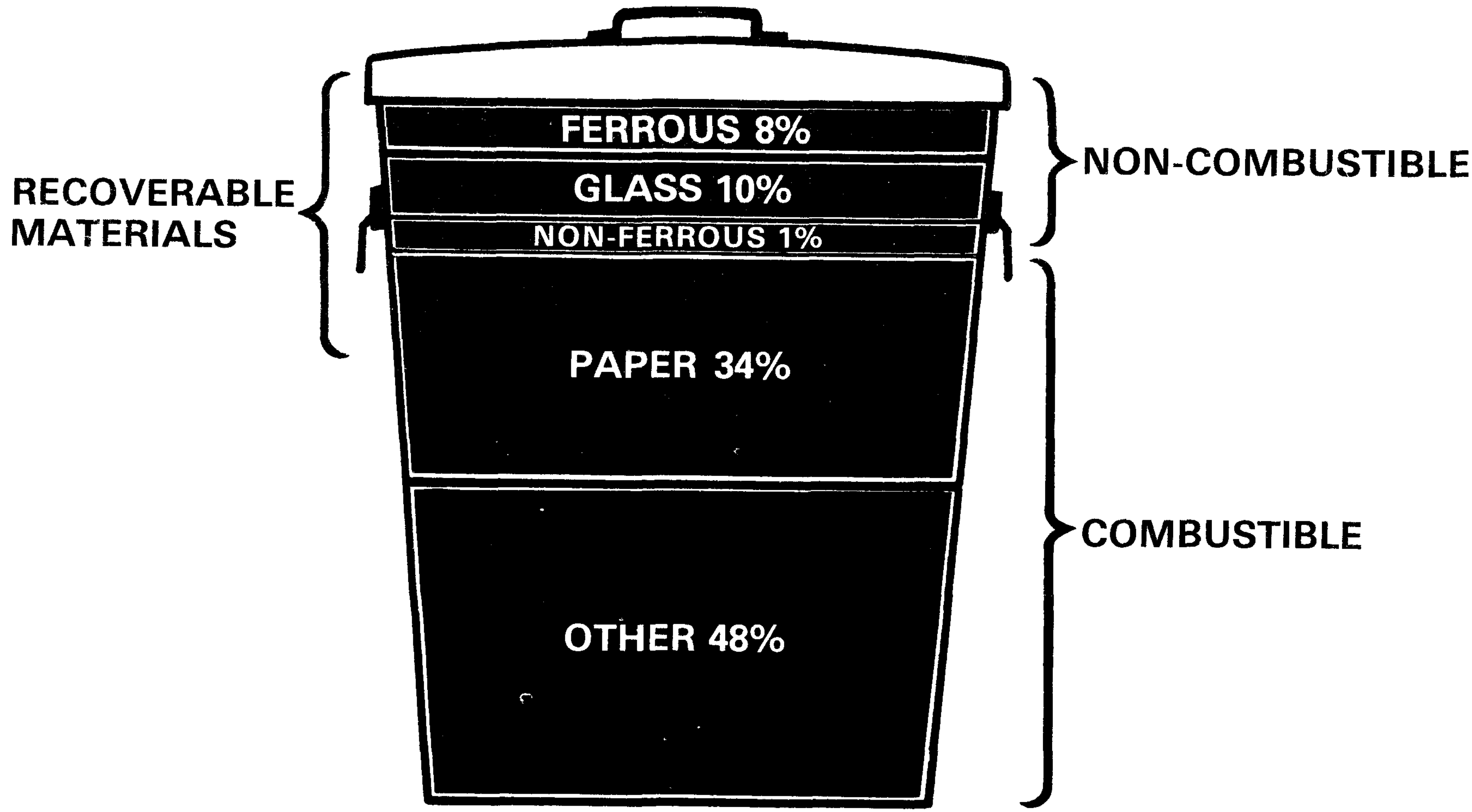
OUTPUTS

SIGNED LONG TERM CONTRACTS
WITH FLOOR PRICES

REMINDERS

- FOLLOWS SELECTION OF TECHNOLOGY, FINANCING, OWNERSHIP/OPERATION, ETC.
- PROBABLE CONTRACTOR RESPONSIBILITY

COMPOSITION OF MUNICIPAL SOLID WASTE



VALUE OF FUELS & ENERGY RECOVERED FROM 1 TON OF MUNICIPAL SOLID WASTE

PRODUCT	OUTPUT	VALUE/UNIT	GROSS VALUE
ELECTRICITY	700 KWH	1.5 — 5 ¢/KWH	\$10.50 — \$35.00
STEAM	6000 lbs	\$2 — 5/1000 lbs	\$12.00 — 30.00
GAS	20,000 ft^3	50 — 75¢/1000ft^3	\$5.00 — 15.00
OIL	1 bbl	\$7 — 11/bbl	\$7.00 - 11.00
RDF	0.7 TONS	\$3 — 12/TON	\$ 2.10 — 8.40

FACTORS INFLUENCING UTILITIES INTEREST IN USING RDF

FACTOR	INFLUENCE
PUBLIC IMAGE	STRONG POSITIVE FACTOR
ECONOMIC INCENTIVE	LITTLE OR NO INCENTIVE
ALTERNATIVE FUEL	NOT A SIGNIFICANT SUPPLY
CONSISTENT WITH MISSION	MAY CONFLICT
TECHNICAL FEASIBILITY	UNCERTAINTIES

DETERMINATION OF RDF VALUE

$$\left\{\begin{array}{c}\text{PRICE OF}\\\text{FOSSIL}\\\text{FUEL}\end{array}\right\} - \left\{\begin{array}{c}\text{INCREMENTAL}\\\text{COST OF}\\\text{USING RDF}\end{array}\right\} = \left\{\begin{array}{c}\text{NET}\\\text{VALUE}\\\text{OF RDF}\end{array}\right\}$$

EXPERIENCE IN MARKETING RDF

	STATUS	USER	PRICE ($/mmBtu)
Ames, Iowa	Operating	Municipal Power Plant	1.00 (Gross)
Chicago, Illinois	Shakedown	Commonwealth Edison Co.	0.30
Milwaukee, Wisconsin	Operating	Wisconsin Elec. Power Co.	To be Negotiated
Monroe County, New York	Construction	Rochester Gas & Elec. Co.	To be Negotiated
Bridgeport, Connecticut	Construction	United Illuminating Co.	To be Negotiated
Lane County, Oregon	Construction	To be Developed	To be Negotiated

EXPERIENCE IN MARKETING STEAM

	STEAM TYPE	USE	PRICE ($/1000 lbs)
NASHVILLE	LOW TEMP./PRESS.	DISTRICT HEATING & COOLING	5.90
SAUGUS	HIGH TEMP./PRESS.	INDUSTRIAL	—
BALTIMORE	LOW TEMP./PRESS.	DISTRICT HEATING	3.00
AKRON	LOW TEMP./PRESS.	DISTRICT HEATING & INDUSTRIAL	3.00

EXPERIENCE IN MARKETING ELECTRICITY

	USER	PRICE (¢/KWH)
HEMPSTED, L.I.	LONG ISLAND LIGHTING CO.	1.7—2.0
DADE CO., FLA.	FLORIDA POWER & LIGHT	—

MATERIALS FROM MUNICIPAL SOLID WASTE

Component	Percent*	Recovery Efficiency	Gross Value ($)	Revenue Per Ton of Waste ($)
Steel	8	75-95	20-50	1.30-3.80
Non-Ferrous	1	40-70	200-350	.80-2.45
Glass	10	40-70	2-30	.10-2.10
Newspaper	6	40-70	10-35	.40-1.50

*National Average

Source: U. S. Environmental Protection Agency, Office of Solid Waste, Resource Recovery Division, April 1977.

Notes: (1) Based on "most likely" outputs and values. Examples outside of these ranges are possible.

(2) These are gross values and do not consider either the cost to produce these products or the cost of transport to a user.

MARKETS FOR FERROUS METAL

USER	FORM	TYPICAL PRICE ($/TON)
DETINNERS	LOOSE NON-INCINERATED	60 - 90% OF NO. 2 BUNDLES
COPPER PRECIPITATORS	LOOSE	
STEEL MILLS	DENSE	
IRON FOUNDRIES		
INTERMEDIATE PROCESSOR	DENSE	

MARKETS FOR FERROUS METAL

USER	FORM	TYPICAL PRICE ($/TON)
DETINNERS	LOOSE NON-INCINERATED	60 - 90% OF NO. 2 BUNDLES
COPPER PRECIPITATORS	LOOSE	
STEEL MILLS / IRON FOUNDRIES	DENSE	
INTERMEDIATE PROCESSOR	DENSE	

MARKETS FOR NON-FERROUS METAL

User	Form	Typical Price* ($/Ton)
Primary Producers	Clean Aluminum	300 - 350
	Medium Aluminum	200 - 250
Secondary Smelters	Mixed Aluminum	200 - 250
Intermediate Processor	Mixed Non-Ferrous	200 - 250

*New York Market Price - March 1977 - F.O.B. Recovery Plants.

MARKETS FOR GLASS

USER	FORM	TYPICAL PRICE * ($/TON)
CONTAINER PLANTS	HIGH PURITY	
— CLEAR	— COLOR SORTED	20—35
— COLOR	— COLOR MIXED	20—30
MISC.	LOW PURITY (80—90% GLASS)	2—5

* NEW YORK MARKET PRICE — MAR. 77 — F.O.B. USER

MARKETS FOR PAPER

USER	FORM	TYPICAL PRICE* ($/TON)
NEWSPRINT MILLS	NEWS	40
CORRUGATED BOARD MILLS	CORRUGATED	40
PRINTING/WRITING	LEDGER	80
BOXBOARD MILLS CONSTRUCTION PAPER MILLS	MIXED NEWS CORRUGATED LEDGER	10

* CHICAGO MARKET PRICE — MAR. 78 — F.O.B. RECOVERY

Example of

Specification for Heavy Ferrous Metals

Composition:	Miscellaneous magnetic steel of various alloys substantially free of cans for foods, beverages, and the like.
Dirt:	Less than 1%.
Loose Organics:	Less than 2%, including small amounts of paint, paper, food wastes, etc.
Physical Description:	Loose, free-flowing pieces, except for miscellaneous lengths of wire.
Piece Size:	95% passing through an 8 x 8 inch screen.
Bulk Density:	In excess of 50 pounds per cubic foot.

Example of

Specification for Light Ferrous

1. Particle Size - 90% 4" or less with not more than 20% being less than 1" nominal in size.

2. Ferrous Density - Ferrous metal density should be between 20 and 24 pounds per cubic foot.

3. The recovered ferrous metals should not be in a balled form which would prevent MC&P's liquid chemical cleaners from reaching 95% of the metals surface.

4. There are no restrictions on inclusions of white goods in the recovered ferrous as long as such white goods are processed through shredder mills prior to magnetic separation and have a particle size not greater than 6" to 8" nominal.

5. Tramp inclusions in the recovered ferrous metal should not exceed 6%.

EXAMPLE OF

PROPOSED INDUSTRY SPECIFICATION FOR ALUMINUM

RECOVERED FROM MIXED MUNICIPAL REFUSE

GRADE A

The scrap aluminum in mixed municipal refuse must be separated from all other materials. If the material is reclaimed using dry processing following thermal treatment of the refuse, it must be baled to a density of 15-25 pounds per cubic foot. If the aluminum is separated from raw refuse or if wet processing techniques are used to separate the aluminum, the aluminum must be shredded or dried prior to baling. The shredded material must pass over a U.S. Standard 12 mesh screen to reduce fines (dust, dirt, sand, paint, etc.). Fines must not exceed three percent (3%) of gross weight. The finished product must be baled to a density of 15-25 lbs./ft.^{3} Alternatively, dry shredded material may be shipped loose if it has a density of 15-25 lbs./ft.^{3} Analyses will be on the melt of a total shipment.

Each shipment shall yield after melting a total net weight of at least 85 percent (85%) of the gross weight of aluminum scrap received and shall contain by chemical analysis the following maximum elements.

ELEMENT	MAXIMUM WEIGHT PERCENT
Si	.30
Fe	.60
Cu	.25
Mn	1.25
Mg	2.0
Cr	.10
Ni	.05
Zn	.25
Ti	.05
Bi	.02
Pb	.02
Sn	.02
Others - Each	.04
Others - Total	.12
Al	remainder

March 1977

EXAMPLE OF

PROPOSED INDUSTRY SPECIFICATION FOR ALUMINUM

RECOVERED FROM MIXED MUNICIPAL REFUSE

GRADE B

The scrap aluminum in mixed municipal refuse must be separated from all other materials. If the material is reclaimed using dry processing following thermal treatment of the refuse, it must be baled to a density of 15-25 pounds per cubic foot. If the aluminum is separated from raw refuse or if wet processing techniques are used to separate the aluminum, the aluminum must be shredded or dried prior to baling. The shredded materials must pass over a U.S. Standard 12 mesh screen to reduce fines (dust, dirt, sand, paint, etc.). Fines must not exceed three percent (3%) of gross weight. The finished product must be baled to a density of 15-25 $lbs./ft.^3$ Alternatively, dry shredded materials may be shipped loose if it has a density of 15-25 $lbs./ft.^3$ Analyses will be on the melt of a total shipment.

Each shipment shall yield after melting a total net weight of at least 85 percent (85%) of the gross weight of aluminum scrap received and shall contain by chemical analysis the following maximum elements.

ELEMENT	MAXIMUM WEIGHT PERCENT
Si	.5
Fe	1.0
Cu	1.0
Mn	1.25
Mg	2.0
Cr	.3
Ni	.3
Zn	1.0
Ti	.05
Bi	.3
Pb	.3
Sn	.3
Others - Each	.05
Others - Total	.15
Al	remainder

March 1977

EXAMPLE OF

SPECIFICATION FOR NONFERROUS METALS

Contents:	Miscellaneous nonferrous metals, including non-magnetic stainless steel.
Size:	100% retained in 1/2 inch screen.
Cleanliness:	Minimum 60% by weight metal.
Form:	Loose, but not balled and dry.

EXAMPLE OF

SPECIFICATION FOR NON-COLOR SORTED GLASS FINES

1. SCREEN SIZING: 0% retained on 2-inch mesh screen. 10% max. through 140 mesh screen.

2. COLOR: Fines to contain only soda lime glass. No color mix specified.

3. LIQUID: No drainage from representative sample. Should be non-caking and free-flowing.

4. ORGANIC MATERIAL: Total paper, plastics and organic materials max. 0.25%.

5. MAGNETIC METAL: .05% max. .25 inch max. size.

6. NON-MAGNETIC METAL:

SIZE	NO. PARTICLES
+20 mesh	1 particle in 40 lbs. (max. size 0.25 inch)

7. SOLID INORGANIC OTHER THAN METAL:

7.1 TOTAL INORGANIC

AMOUNT: Max. 0.10% (nonrefractory)
SIZE: Max. 0.25 inch

7.2 REFRACTORY

SIZE	NO. PARTICLES
+20 mesh	1 particle in 40 lbs. (Max. size 0.25 inch)
-20+40 mesh	2 particles in 1 lb.
-40+60 mesh	20 particles in 1 lb.

Special note -- it is anticipated that this product will be from flotation and size reduction processes where non-magnetic metals and refractory particles will have been removed.

Example of

Specification for Waste Newspapers

Consists of newspaper packed in bales of not less than 54 inches in length, containing less than five percent of other papers.

Prohibitive materials may not exceed 0.5%

Total outthrow may not exceed. 2%

Source: Paper Stock Institute of America, Specification Circular PS-72.

ADVANCE LETTER OF INTENT TO BID FOR THE PURCHASE OF RECOVERED PRODUCTS

WHEREAS, the ____ Corporation (hereinafter called the CORPORATION) endorses resource recovery from municipal solid waste as a means toward a cleaner environment and preservation of natural resources; and,

WHEREAS, the CORPORATION recognizes the need to develop firm expressions of intent to purchase materials or energy products recovered from waste within known financial parameters as part of the planning process for a new endeavor such as this; and,

WHEREAS, the City of Anytown (hereinafter called the JURISDICTION), is evaluating the prospects of substituting resource recovery for the traditional means of solid waste disposal in its area; and,

WHEREAS, the JURISDICTION recognizes the need to establish product revenue bases for the determination of the economic feasibility of processing up to _______ tons per day of municipal solid waste to produce up to _______ tons per day of ____________________ (hereinafter known as the PRODUCT) in a form usable and acceptable to the CORPORATION according to the Specifications attached to the AGREEMENT and made part hereof; and, WHEREAS, the JURISDICTION may wish to assign this AGREEMENT to either public or private groups (hereinafter called the ASSIGNEE) who may operate a resource recovery facility for the JURISDICTION and thus have a requirement for a user of the quantity of PRODUCT herein described.

THEREFORE, in consideration of the fact that the legal authority to sell recovered products may rest upon a requirement to advertise for the purchase of such products, it is mutally agreed between the CORPORATION the JURISDICTION that:

I. The CORPORATION, as an expression of its support of the municipal solid waste recovery program, agrees to:

(1) offer herein a firm commitment to bid for the purchase of _____ tons per day of the recovered PRODUCT at prices not less than those entered here should the JURISDICTION or its ASSIGNEE be required or decide to effect a competitive procurement; and,

(2) agrees that if public bidding is not necessary and not the course chosen by the JURISDICTION or its ASSIGNEE, then the conditions of the AGREEMENT may be considered as a bona fide offer to purchase the recovered PRODUCT at prices not less than those stated here.

(3) respond, should a bid be required, with a bona fide offer to purchase which will include the following:

(a) It will be a firm bid for five (5) years offering an Exchange Price either fixed or related to a commodity quote, and if the Exchange Price is not fixed, it will offer a Floor Price below which the Exchange Price will not fall during the term of the contract.

(b) The periodic price paid shall be $____ less than the _____ of the previous period's quotations published in ____ ____________________________________.

(c) If the Exchange Price is not fixed, a Floor Price will be bid which will not be below $___ ___ per ton f.o.b. (fill in dollar amount) the recovery facility (or CORPORATION'S plant - choose one).

(d) The CORPORATION shall retain the right to reject any material delivered which does not meet Specifications. Such rejection will be at the expense of the resource recovery plant.

(e) The bid will be subject to force majeur.

(f) It will be noted the Additional Conditions of the CORPORATION covering general terms and conditions of purchase, acceptance delivery, arbitration, weights, and downgrading not explicitly covered in the Letter of Intent or by reference, will be negotiated according to good business practices and include such Additional Conditions as are attached to this AGREEMENT and made a part hereof.

(g) This AGREEMENT is null and void if during the period between its execution and the actual bid or negotiated contract the CORPORATION'S plant ceases operation or ceases use of this or equivalent grade of recovered PRODUCT.

II. In accepting the assignment of this AGREEMENT, the JURISDICTION or its ASSIGNEE agrees:

(1) to see that the recovery plant establishes specification assurance procedures for the recovered PRODUCT, using good industrial quality control practices in recognition of the CORPORATION's use technology as practiced in their ____________________ plant, so as to produce and offer the recovered PRODUCT for sale in a form and to the required Specification, usable in the plant with minimum alterations to present processing technology and business practices, and

(2) to require, should a contract be effected as a result of this AGREEMENT, that the PRODUCT be delivered to the CORPORATION according to conditions and prices determined herein and not diverted to the spot market which may on occasion be higher than the Exchange Price determined by the pricing relationship set forth here or as modified by the contract.

(3) that should the CORPORATION's plant, as specified herein, become saturated in its

ability to handle the recovered PRODUCT as a result of other Letters of Intent issued by the CORPORATION being converted into firm contracts for delivery and purchase prior to effecting such arrangements as a result of this commitment, the provisions of this AGREEMENT become null and void.

The JURISDICTION will consult with and obtain the approval of the CORPORATION concerning its intent to assign this AGREEMENT to any ASSIGNEE prior to such assignment.

The CORPORATION will communicate to the JURISDICTION or its ASSIGNEE that information about its use, technology and business practices which the CORPORATION at its sole discretion shall consider necessary so as to assure receipt of the recovered material in form and cleanliness necessary for use by the CORPORATION. Such communication shall be on a nonconfidential basis, unless otherwise subject to a subsequent confidentiality agreement.

The JURISDICTION in executing this AGREEMENT does not represent or bind itself to any obligation, legal or otherwise, that a resource recovery plant will in fact be constructed or placed into operation as a result of its present efforts.

This AGREEMENT shall become null and void on ____________ without any obligation on either party unless steps toward assignment are made or it is mutually extended by both the CORPORATION and the JURISDICTION.

Witnessed by: JURISDICTION

_____________________________ By: ____________________________

_____________________________ Date: __________________________

Witnessed by: CORPORATION

_____________________________ By: ____________________________

_____________________________ Date: __________________________

ATTACHMENT

Specification for ____

Source Separation

MATERIALS RECOVERY THROUGH SOURCE SEPARATION

I. INTRODUCTION

  A. Outline of talk

  B. Waste stream composition

  C. Percentage of waste stream recycled

  D. Recycling centers

II. SINGLE MATERIAL RECYCLING

  A. Aluminum can recycling

  B. Paper recovery techniques

    1. Corrugated paper

    2. High-grade office paper

      a. Office waste stream composition

      b. Office paper separation case studies

    3. Newsprint recovery

      a. Separate collection - Fort Worth, Texas

      b. Piggyback approach

        (1) Rack - Madison, Wisconsin

        (2) Other piggyback methods

III. MULTI-MATERIAL SOURCE SEPARATION

- A. Somerville-Marblehead
- B. Other multi-material programs

IV. IMPLEMENTATION OF SOURCE SEPARATION

- A. Success factors
- B. Contractual elements
- C. Factors influencing participation rate
- D. Publicity techniques
- E. Management plan

CONTRACT PRICE STRUCTURE

	MARBLEHEAD		SOMERVILLE	
	FLOOR PRICE	1976 RANGE	FLOOR PRICE	1976 RANGE
PAPER	\$5	\$12 — \$27	\$2	\$6 — \$21
GLASS	\$12	\$12	\$10	\$10
CANS	\$10	\$10 — \$16	\$5	\$5 — \$14

WASTE STREAM COMPOSITION (1974)

	% IN SOLID WASTE STREAM	% RECYCLED
PAPER		
NEWSPRINT	7.1	21.0
CORRUGATED	10.0	25.0
OFFICE PAPER	4.4	13.0
OTHER PAPER	14.2	8.6
GLASS	8.4	2.0
FERROUS CANS	4.1	1.0
ALUMINUM CANS	0.4	11.0
OTHER	51.4	0.0

WASTE COMPOSITION AT EPA HEADQUARTERS

	PERCENT
PAPER	
WHITE LEDGER	40.2
COMPUTER TAB CARDS	0.7
COMPUTER PRINTOUT	10.6
COLORED LEDGER	3.3
NEWSPRINT	12.5
CORRUGATED	5.6
OTHER PAPER	13.4
OTHER WASTE	13.8

RECOVERY LEVELS
1976

	MARBLEHEAD	SOMERVILLE
RECOVERY RATE	25%	8%
TONNAGE PER MONTH:		
PAPER	92.5	134
GLASS & CANS	91.5	90
TOTAL	184	224

SOMERVILLE-MARBLEHEAD COST ANALYSIS (1976)

	Somerville	Marblehead
Revenue	$32,449	$34,003
Disposal Savings	36,225	37,406
Incremental Collection Costs	70,629	43,649
Net Savings	(1,825)	27,760

Compatibility

COMPATIBILITY

I. COMPATIBILITY ISSUE - DO ALTERNATIVE APPROACHES CONFLICT?

A. Source separation

B. Beverage container deposits

C. Energy and materials recovery plants

II. IMPACT OF SOURCE SEPARATION OF PAPER ON ENERGY RECOVERY PLANTS

A. Quantity of paper recoverable

B. Impact on Btu content of solid waste

C. Impact on economics of an energy recovery plant

III. IMPACT OF CONTAINER DEPOSITS ON SOURCE SEPARATION AND MECHANICAL RECOVERY

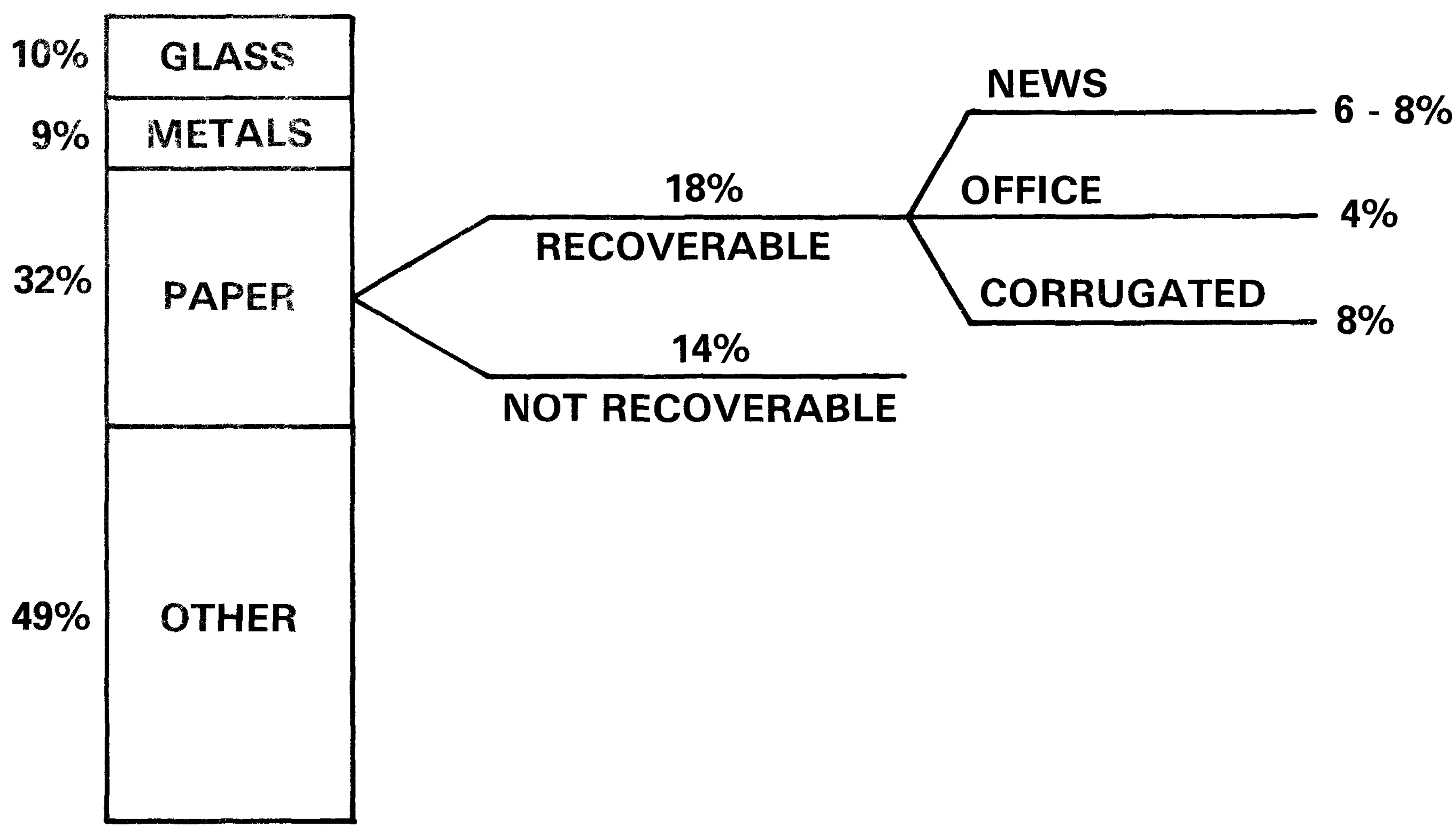
A. Quantity of metals and glass removed through deposits

B. Impact on economics of mechanical recovery

C. Impact on source separation

IV. CONCLUSIONS

POTENTIAL FOR PAPER SEPARATION



PAPER SEPARATION PROGRAMS -

WHAT IS IMPACT ON BTU CONTENT?

	BTU CONTENT	REDUCTION
No Paper Separation	4600 BTU/lb	
Paper Separation (3-6 Percent Recovery)	4450	3%

WHAT IS IMPACT ON TIPPING FEE?

	TIPPING FEE	INCREASE
No Paper Separation	$8.50	None
Paper Separation	$8.65	2%

CONTAINERS AS A PERCENT OF MATERIALS

IN SOLID WASTE

	Containers as a Percent of Components
. Ferrous	15%
. Aluminum	38%
. Glass	45%

IMPACT OF CONTAINER DEPOSITS ON MECHANICAL SEPARATION ECONOMICS

	Increased Costs ($/Ton Incoming Waste)
Case A	
Plants That Don't Include Glass/Aluminum Recovery	
Fe Recovery	.30 - .40
Glass/Aluminum	0
	.30 - .40
Case B	
Plant with Glass/Aluminum Recovery Operations with Reduced Revenues	
Fe Recovery	.30 - .40
Glass/Aluminum	.40 - .50
	.70 - .90
Case C	
Plant Discontinues Glass/Aluminum Recovery	
Fe Recovery	.30 - .40
Glass/Aluminum	.70 -2.00
	1.00 -2.40

Mechanical Processing

MECHANICAL PROCESSING AND RECOVERY

I. INTRODUCTION - "ADD-ON" CONCEPT

II. PREPROCESSING FOR MATERIALS RECOVERY

A. Dry processing

1. Shred
2. Air classify
3. "Light" and "heavy" fractions

B. Wet processing

1. Hydropulper
2. Liquid cyclone

III. MATERIALS RECOVERY SUBSYSTEMS

A. Paper fiber recovery

1. Equipment
2. Product
3. Franklin, Ohio demonstration results

B. Ferrous metals recovery

1. Equipment
2. Product
3. Postcombustion recovery

C. Glass and nonferrous metals concentrates

1. Trommel
2. Jig

D. Nonferrous metals recovery

1. Recovery of a mixed nonferrous product

2. Recovery of an aluminum product

   a. Concept

   b. Product characteristics

3. Recovery equipment

   a. Jig

   b. Eddy current separator

4. Economics of aluminum recovery

E. Glass recovery

1. Recovery of glassy aggregate

   a. Recovery techniques

   b. Uses of aggregate

2. Cullet recovery

   a. Froth flotation

      (1) Equipment

      (2) Product

      (3) Economics

   b. Color sorting

      (1) Equipment

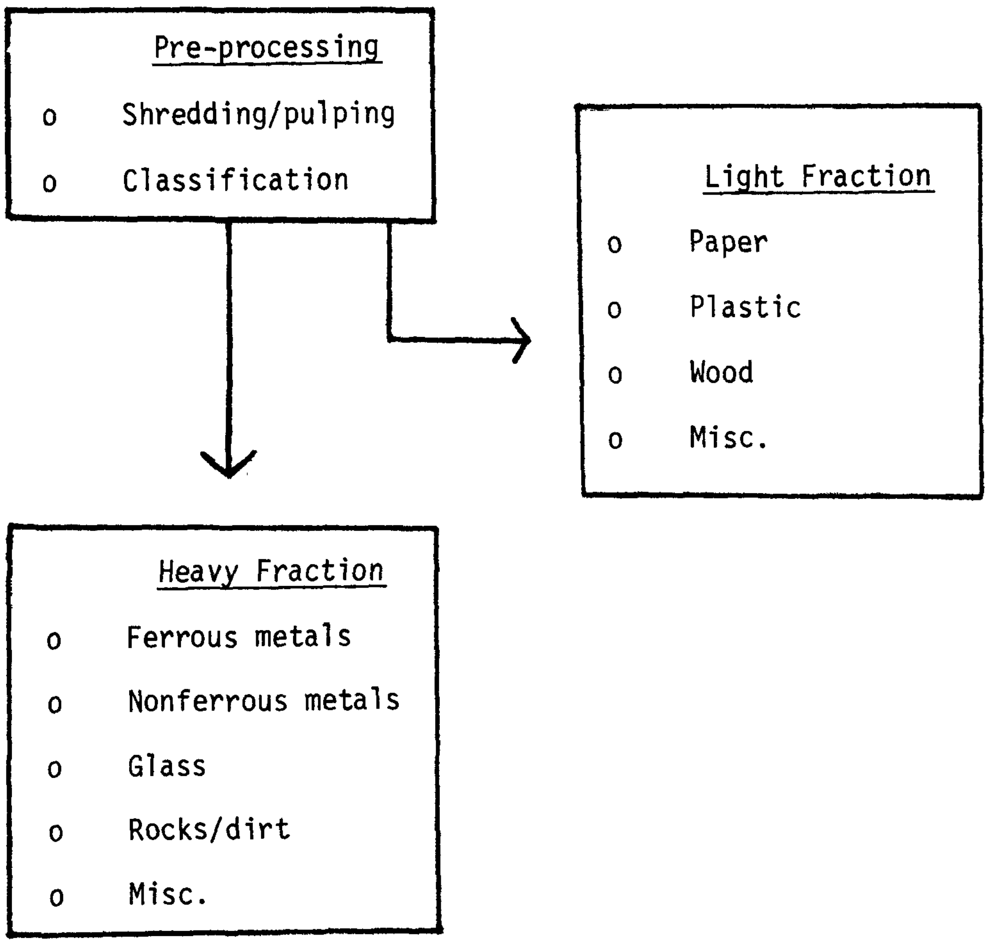
      (2) Product

      (3) Franklin, Ohio demonstration results

IV. STATUS OF IMPLEMENTATIONS FOR GLASS AND METALS RECOVERY

V. SUMMARY OF MATERIALS RECOVERY THROUGH MECHANICAL PROCESSES

MATERIALS RECOVERY PROCESSING



COMPOSITION OF HEAVY FRACTION[1]
FROM AIR CLASSIFICATION

Combustibles	37.5
Glass	28.5
Ferrous	11.4
Non-Ferrous	6.8
Other Non-Combustibles	15.8

[1]Average based on tests at the St. Louis RDF plant and the NCRR Environmental Test and Evaluation Facility in Washington, D. C. Assumes that 90 percent of ferrous metals are removed.

ALUMINUM RECOVERY ECONOMICS

	$/Ton Raw Waste Input
Probable Gross Revenues	0.75 - 2.00
Probable Processing Costs	0.75 - 1.25
Net Revenues	(0.50)- 1.25

GLASS CULLET RECOVERY ECONOMICS

(FROTH FLOTATION)

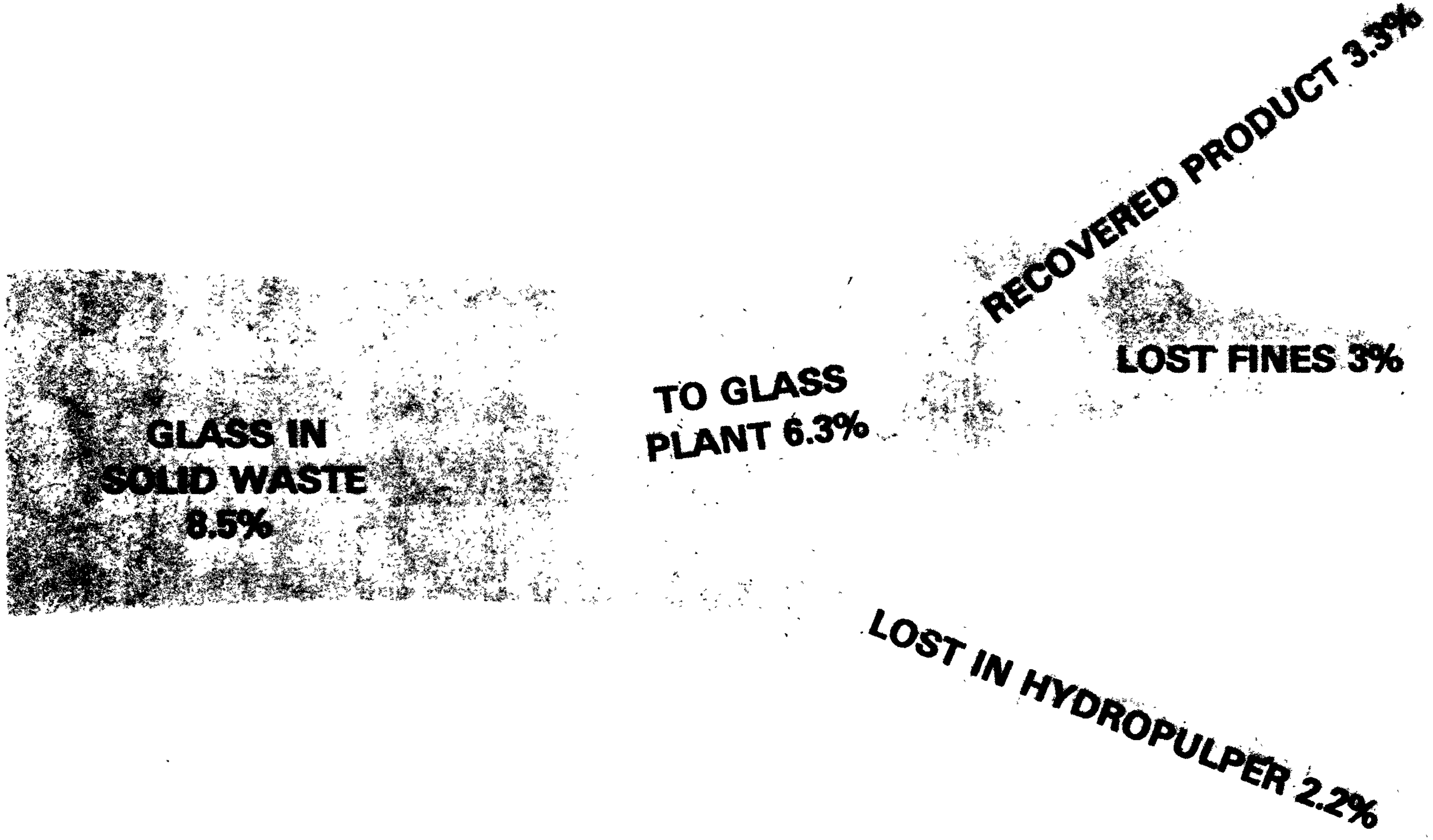
	$/Ton Raw Waste Input
Probable Gross Revenues	0.50 - 1.75
Probable Processing Costs	1.25 - 2.00
Net Revenues	(1.50)- 0.50

GLASS CULLET RECOVERY ECONOMICS

(Color Sorting)

	Dollars/ton raw waste input	
	(500 tpd msw facility)	(1000 tpd msw facility)
Probable gross revenues (includes glass and misc. ferrous and nonferrous metals)	$2.78	$2.78
Probable processing and facility amortization costs	$3.46	$2.30
NET COST (profit)	$ .68	($.48)

EFFICIENCY OF GLASS RECOVERY
FRANKLIN OHIO



STATUS OF NON-FERROUS RECOVERY

	OPERATIONAL	SHAKEDOWN	UNDER CONSTRUCTION
JIGGING	FRANKLIN, OHIO (DEMO)		HEMPSTEAD, N.Y.
EDDY CURRENT SEPARATION	AMES, IOWA	SAN DIEGO, CAL. (DEMO) BALTIMORE CO., MD. (DEMO)	MILWAUKEE, WISC. NEW ORLEANS, LA. MONROE CO., N.Y. BRIDGEPORT, CONN.

STATUS OF GLASS RECOVERY

	OPERATIONAL	SHAKEDOWN	UNDER CONSTRUCTION
COLOR SORTING	FRANKLIN, OHIO (DEMO)		HEMPSTEAD, N.Y.
FROTH FLOTATION		SAN DIEGO, CAL. (DEMO)	NEW ORLEANS, LA. BRIDGEPORT, CONN. MONROE CO., N.Y.
GLASS RICH CONCENTRATE	AMES, IOWA	BALTIMORE CO., MD. (DEMO)	MILWAUKEE, WISC.

Direct Combustion

DIRECT COMBUSTION OF SOLID WASTE

I. INTRODUCTION

A. Systems

1. Waterwall combustion - mass burning
2. Waterwall combustion - processed waste
3. RDF

B. Variations

1. Adapt system to waste
2. Adapt waste to system
3. Adapt both

II. WATERWALL COMBUSTION - MASS BURNING

A. History

B. Terms

C. Profile

1. 260 plants world-wide
2. Size
3. Age
4. Exportable energy products

D. Description of technology

E. American experience

1. Chicago
2. Harrisburg
3. Saugus
4. Norfolk
5. Portsmouth
6. Nashville
7. Oceanside

F. Implementations: Europe vs. America

1. Land
2. Energy
3. Markets
4. Commitment

III. WATERWALL COMBUSTION - PROCESSED WASTE

A. Advantages/Disadvantages

1. Fuel preparation
2. Combustion method
3. Materials recovery

B. Experience

1. Hamilton
2. Akron
3. Niagara Falls
4. Dade County
5. Hempstead

IV. SMALL STEAM GENERATORS

A. Approach: Europe vs. America

B. American technology

C. Application

D. Experience

1. Siloam Springs
2. Blytheville
3. Groveton
4. North Little Rock
5. Crossville
6. Industrial sites

E. Environmental considerations

V. CONCLUSIONS

A. Available technology

1. Waterwall combustion - mass burning

2. Waterwall combustion - processed waste

3. Small steam generators

B. History of success

1. Waterwall combustion - mass burning

2. Processed waste and steam generators

C. Commitment

PROFILE OF EUROPEAN REFUSE FIRED STEAM GENERATORS

CATEGORY	PERCENT OF TOTAL SYSTEMS
SIZE	
• UNDER 500 T/D	68
• 500 TO 1000 T/D	16
• OVER 1000 T/D	16
DATE CONSTRUCTED	
• BEFORE 1960	6
• 1960 — 1970	50
• AFTER 1970	44
PRIMARY ENERGY PRODUCT	
• HOT WATER — DISTRICT HEAT	27
• STEAM — DISTRICT HEAT	33
• ELECTRICITY	40

AMERICAN EXPERIENCE
MASS BURNING

LOCATION	CAPACITY T/D	STATUS
• CHICAGO	1600	OPERATIONAL, NO STEAM RECOVERY
• HARRISBURG	720	OPERATIONAL, NO STEAM RECOVERY
• NASHVILLE	720	OPERATIONAL
• SAUGUS	1200	OPERATIONAL
• U.S. NAVY		
NORFOLK	360	OPERATIONAL
PORTSMOUTH	180	OPERATIONAL
• BRAINTREE	240	OPERATIONAL
• OCEANSIDE	350	OPERATIONAL

EXPERIENCE

EUROPEAN	— VS — AMERICAN
• LACK OF ALTERNATIVE DISPOSAL/NO LAND	• ALTERNATIVE DISPOSAL AVAILABLE/CHEAP LAND
• COSTLY ENERGY	• CHEAP ENERGY
• FAVORABLE INSTITUTIONAL FACTORS • WASTE RESPONSIBILITY • MARKETS	• COMPLEX INSTITUTIONAL FACTORS
• COMMITMENT • FINANCIAL • MANAGEMENT	• LESS COMMITMENT
	• BAD PRESS
	• LOOK FOR CHEAPER OPTION
	• NOT INVENTED HERE

WATERWALL COMBUSTION/ PROCESSED WASTE

FUEL PREPARATION

- SHREDDING
- PULPING

COMBUSTION

- SEMI-SUSPENSION

PRODUCTS

- STEAM
- ELECTRICITY

AMERICAN EXPERIENCE
PROCESSED WASTE

LOCATION	CAPACITY T/D	STATUS
HAMILTON	600	OPERATING
AKRON	1,400	UNDER CONSTRUCTION
HEMPSTEAD	2,000	UNDER CONSTRUCTION
DADE COUNTY	3,000	UNDER CONSTRUCTION
NIAGARA FALLS	2,500	UNDER CONSTRUCTION

SMALL STEAM GENERATORS APPROACH

EUROPEAN	AMERICAN
• SCALE DOWN/ FIELD ERECTED	• PACKAGED UNITS/ SHOP FABRICATED
• CONTINUOUS OPERATION	• CYCLIC OPERATION
• WATERTUBE WALLS	• WASTE HEAT BOILERS
• EXPENSIVE	• LESS EXPENSIVE

SMALL STEAM GENERATORS APPLICATIONS

CAPACITY RANGE — SOLID WASTE — 10 TO 100 TPD

— STEAM FLOW — 5,000 TO 50,000 POUNDS/HR

- SMALL COMMUNITIES
- INSTITUTIONS/INDUSTRIES
- LARGER COMMUNITIES (MULTIPLE UNITS)

SMALL MUNICIPAL STEAM GENERATORS EXPERIENCE

LOCATION	CAPACITY T/D	STATUS
GROVETON, N.H.	45	OPERATIONAL
BLYTHEVILLE, ARK.	50	OPERATIONAL
SILOAM SPRINGS, ARK.	20	OPERATIONAL
CROSSVILLE, TENN.	60	OPERATIONAL
NORTH LITTLE ROCK, ARK.	100	OPERATIONAL

Refuse-derived Fuel

REFUSE-DERIVED FUEL

I. INTRODUCTION

  A. Technology

  B. Operating results

  C. Review of recent implementations

II. TECHNOLOGY

  A. Production of RDF

    1. Types of RDF

      a. Fluff

      b. Powder

      c. Densified

    2. Characteristics of RDF vs. coal

    3. Fluff RDF production system

    4. Powder RDF production system

    5. Densified RDF production system

  B. Use of RDF as supplementary fuel

    1. Existing boilers designed to fire coal

      a. Suspension

      b. Grate and semisuspension

    2. Cement kilns

III. OPERATING RESULTS

  A. St. Louis project

    1. Test facility - operated intermittently from 1972-1976

    2. Process system

3. RDF product

4. Power plant facilities

5. Processing plant operating results

6. Power plant operating results

B. Ames project

1. Full-scale "commercial" facility

2. Process system

3. Power plant facilities

4. Processing plant operating results

5. Costs

IV. REVIEW OF RECENT IMPLEMENTATIONS

A. Plants in shakedown

1. Milwaukee - Fluff RDF

a. Process system

b. Power plant facilities

c. Americology/WEPCO agreement

d. Status

2. Chicago - Fluff RDF

a. Process system

b. Power plant facilities

c. Status

B. Powder and densified RDF test facilities

1. Powder RDF

a. Process system

b. Test burns

2. Densified RDF

a. Process system

b. Test burns

C. Plants under construction

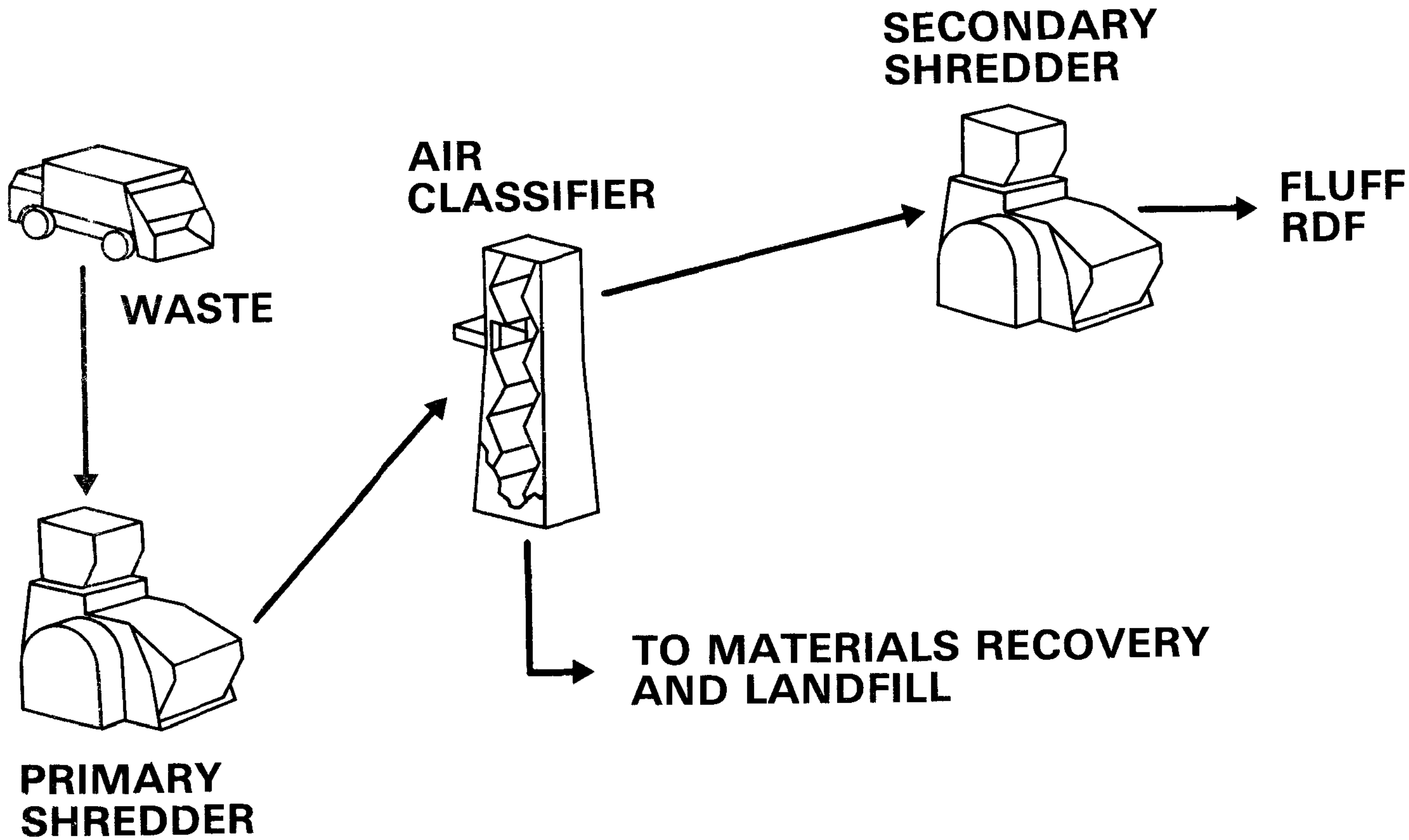
1. Bridgeport, Connecticut

2. Lane County, Oregon

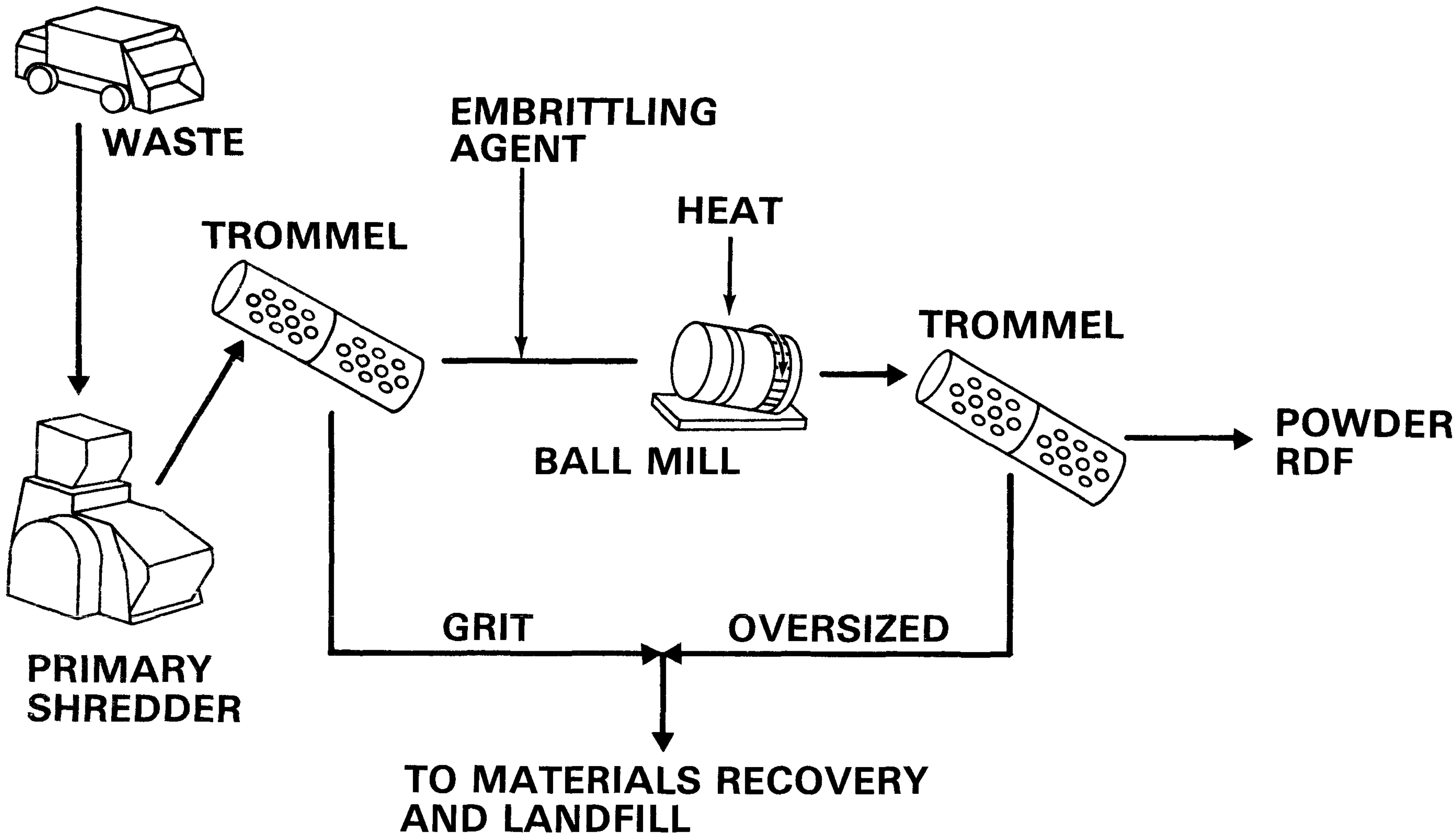
3. Monroe County, New York

V. SUMMARY

PROCESSING STEPS
FLUFF RDF



PROCESSING STEPS: POWDER RDF



CHARACTERISTICS OF RDF AND COAL

	Fluff	Powder*	Coal
Heat Value (BTU/lb)	4,500-6,000	7,800	11,000-14,000
Particle Size (in)	½-1½	<0.015	-
Moisture (%)	20-30	2.0	3-12
Ash (%)	15-25	9.4	3-11
Sulfur (%)	0.1-0.5	0.1-0.6	0.5-4.3

*Data provided by CEA

RDF PARTICULATE EMISSIONS

- St. Louis emissions not typical
  - Each situation is different
- Need air pollution control engineer
  - St. Louis data on resistivity, size distribution, gas flow rates, etc.
  - Consider your project: ash, moisture, sulfur content of fuels; collection efficiency; boiler operation; etc.
- If problem expected
  - Reduce RDF firing rate
  - Reduce boiler load
  - Beef up APC equipment

AMES EXPERIENCE POWER PLANT

- SPREADER – STOKERS
  - CONTINUOUS FIRING
  - UP TO 50% RDF
  - EXCELLENT BURNOUT
  - SLAGGING
- SUSPENSION UNIT
  - POOR BURNOUT
  - LITTLE FIRING EXPERIENCE
  - INSTALLING GRATE

AMES EXPERIENCE PROCESSING PLANT

- AVERAGE THROUGHPUT 150 TPD
- WASTE QUANTITY OVERESTIMATED
- DUSTY PROCESSING AREA
- ALUMINUM RECOVERY NOT OPERATIONAL

AMES ECONOMICS

	Cost per Ton
Capital Cost	$14.50
($6.3 million, 7%, 20 years)	
Operating Cost	13.00
Revenues	
RDF ($7.80)	
Ferrous ($3.25)	(11)
Net Cost	$16.50

MILWAUKEE SUMMARY

- 1,200 tpd; fluff RDF
- Operational spring 1977
- Low quality RDF - slagging
- Shakedown/modification stage
- WEPCO
- Full service contract with American Can

CHICAGO SUMMARY

- 1,000 tpd; fluff RDF
- Operational 1978
- Commonwealth Edison
- EPA evaluation
- A&E; G.O. bonds; city operation

BROCKTON SUMMARY

- 20 tph; powder RDF
- CEA
- Demo/test facility
- Operational spring 1977
- Test burns at Waterbury, CT

D - RDF PRODUCTION

500 tons produced

Textiles jammed pelletizer

Die wear

No problem with moisture

Power: 6-8 KW-HR/ton

Costs: $3-6/ton

Savings

D - RDF FIRING

20/40/100% of fuel requirement

No major problems

Air emissions

- Particulates: No change
- SO_x: Decreased
- Cl: Increased

RDF PROJECTS UNDER CONSTRUCTION

Location	RDF	Size	RDF User
Bridgeport, Connecticut	Powder	1,800 tpd	UI
Lane County, Oregon	Fluff	400 tpd	UO
Monroe County, New York	Fluff	2,000 tpd	RG&E

WHO HAS (WILL HAVE) EXPERIENCE?

CONSULTING ENGINEERS

St. Louis - Horner & Shifrin, Inc.

Ames - Henningson, Durham & Richardson

Chicago - Ralph M. Parsons Co.; Consoer Townsend & Associates

CONTRACTORS

Milwaukee - American Can Co.

Bridgeport, CT - Combustion Equipment Associates, Inc.; Occidental Research Corporation

Monroe County, NY - Raytheon Service Co.

Lane County, OR - Allis-Chalmers

Pyrolysis

PYROLYSIS

I. INTRODUCTION

A. Definition

B. Process parameters

C. Major systems

II. UNION CARBIDE PROCESS

A. Description

B. Status

III. ANDCO PROCESS

A. Description

B. Status

IV. SAN DIEGO

A. Process description

1. Preliminary processing

2. Organic pretreatment

3. Flash pyrolysis

B. Project status

V. BALTIMORE

A. Process description

1. Receiving and storage

2. Shredding

3. Storage of shredded waste

4. Waste firing

5. Pyrolysis kiln

6. Afterburner

7. Steam production and distribution

8. Air pollution control equipment

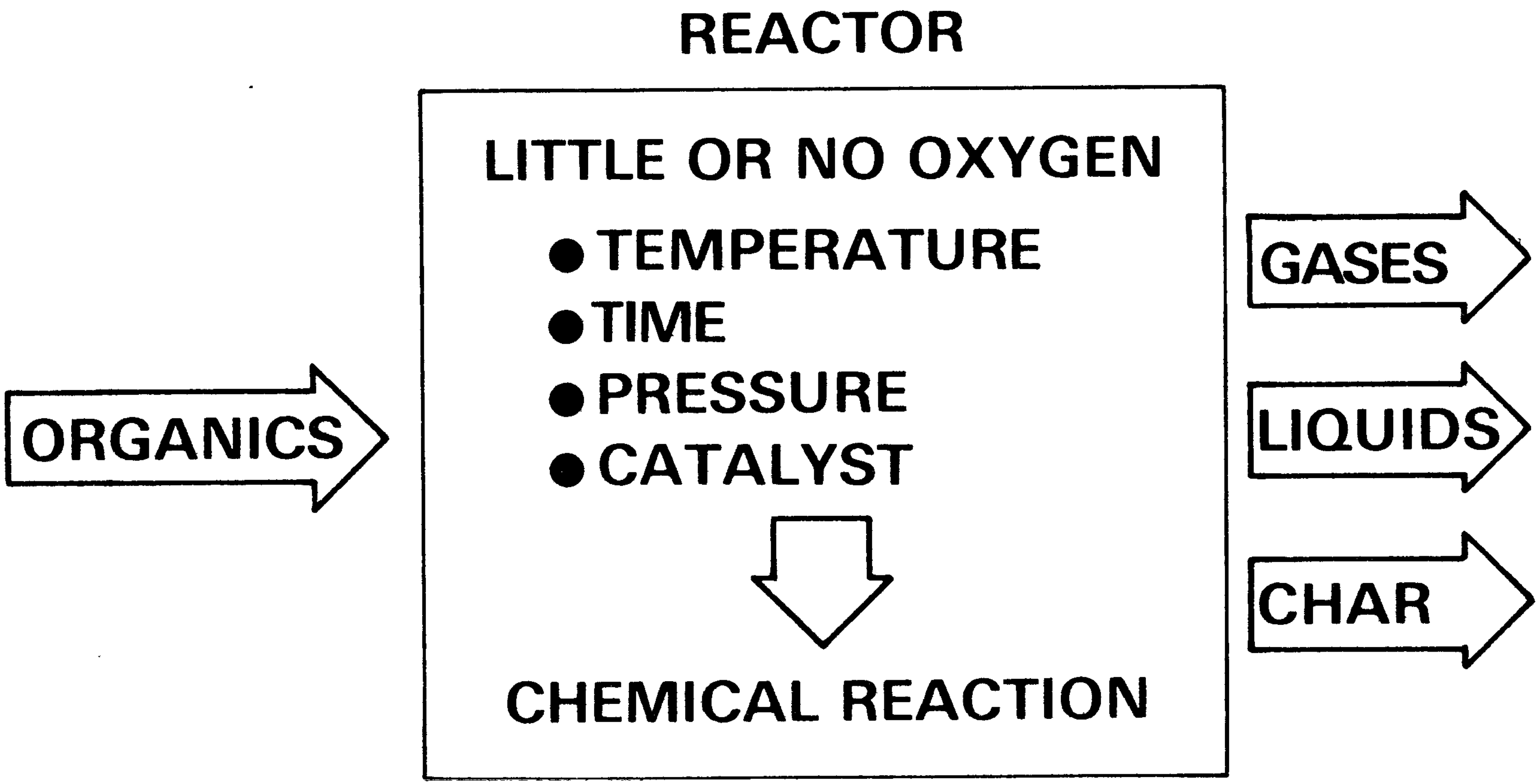
9. Residue handling

B. Project status

C. Problems and solutions

VI. LESSONS LEARNED

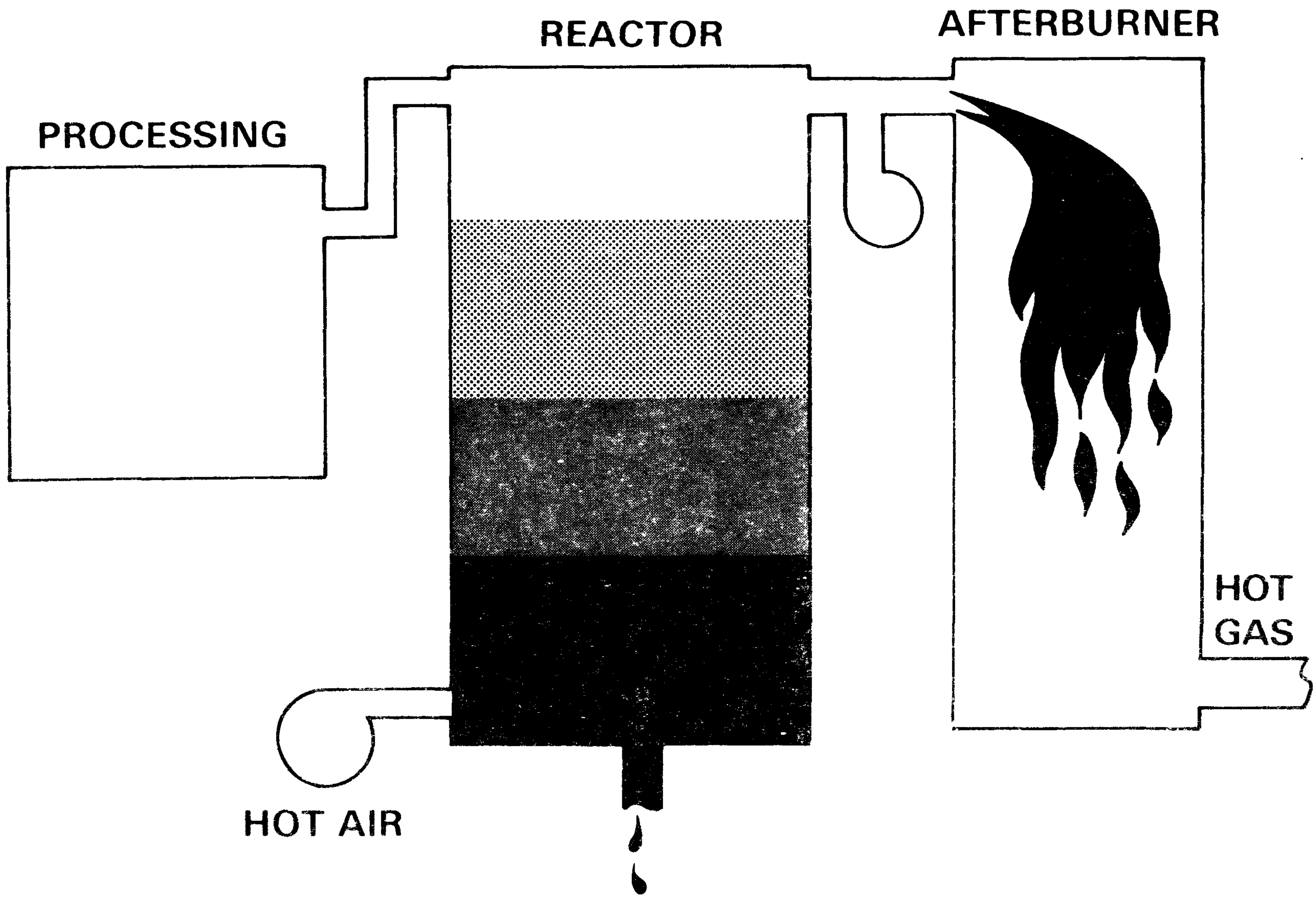
PRODUCTS OF PYROLYSIS



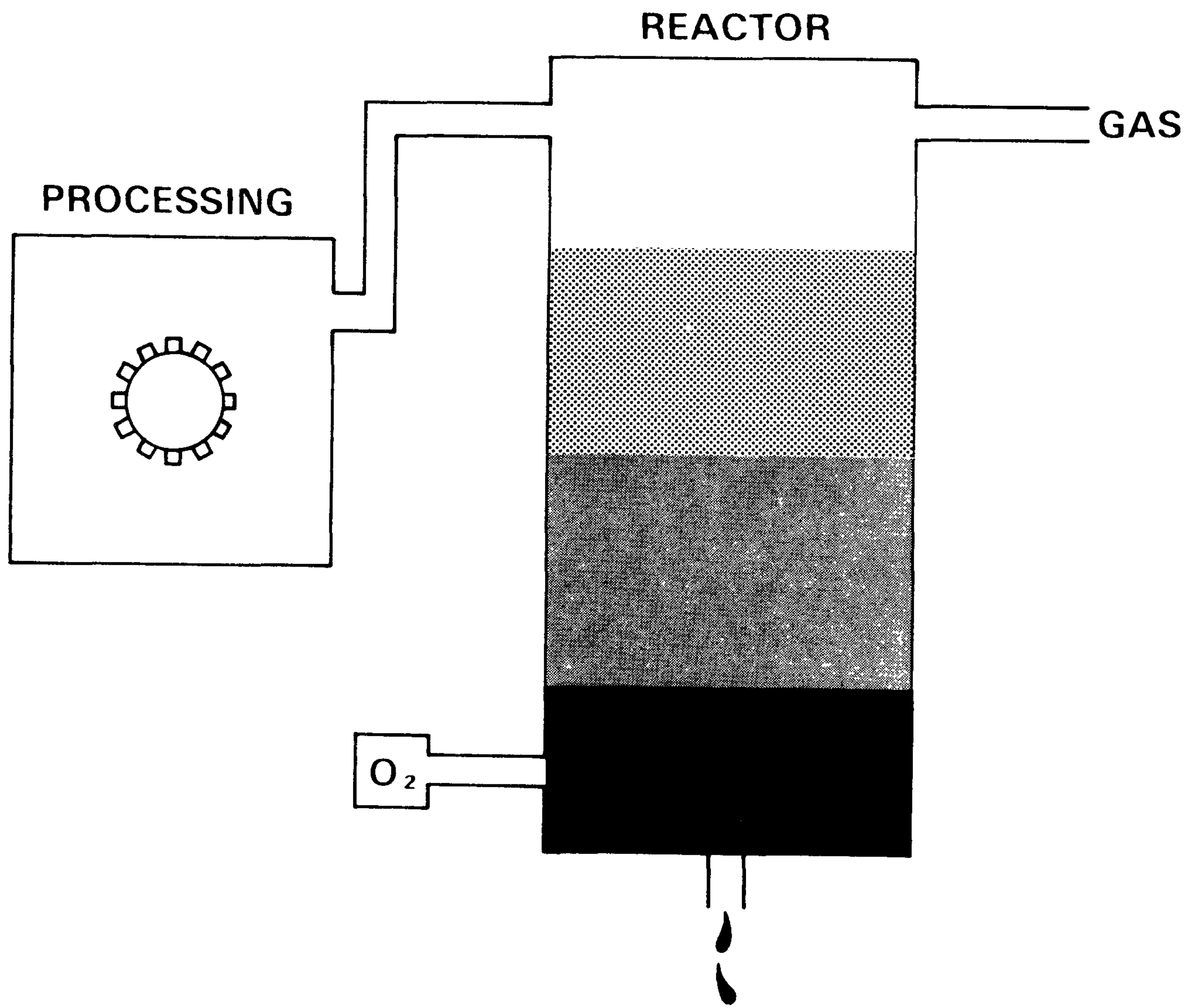
PYROLYSIS

PROCESS	PRODUCT	STATUS
LANDGARD (MONSANTO)	LOW BTU GAS FOR ON-SITE STEAM GEN.	EPA BALTIMORE DEMO (1,000 TPD)
FLASH PYROLYSIS (OCCIDENTAL PETROLEUM)	OIL-LIKE LIQUID FUEL	EPA SAN DIEGO DEMO (200 TPD)
PUROX (UNION CARBIDE)	MEDIUM BTU GAS	S. CHARLESTON W. VA., PILOT PLANT (200 TPD)
TORRAX (ANDCO)	LOW BTU GAS FOR ON-SITE STEAM GEN.	COMMERCIAL PLANT (200 TPD) IN LUXEMBOURG

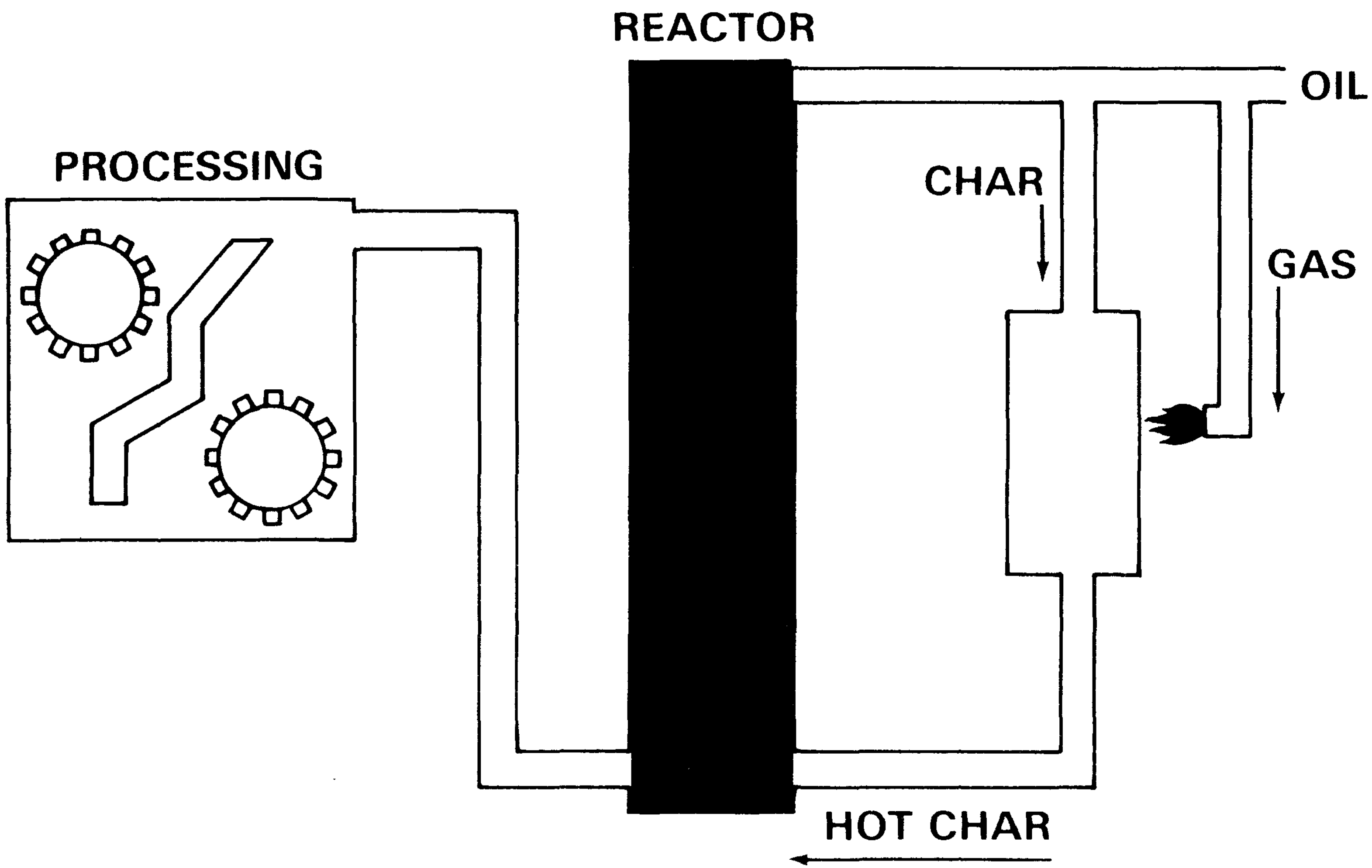
TORRAX



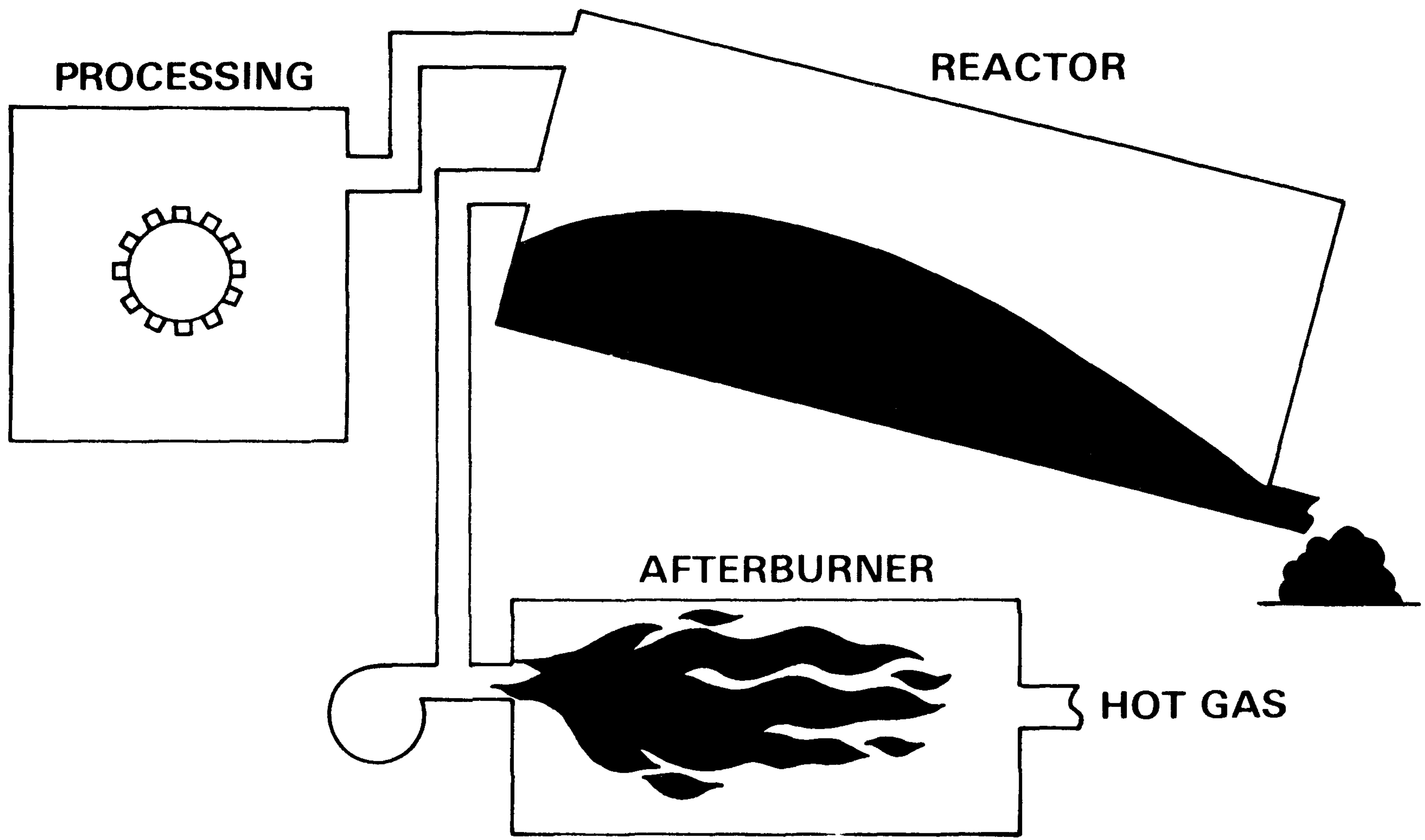
PUROX



ORC



BALTIMORE



Co-disposal

CO-DISPOSAL

I. INTRODUCTION

A. Sludge disposal methods

1. Landfilling

2. Land application

3. Ocean dumping

4. Incineration

B. Incineration technques

1. Multiple hearth furnace

2. Fluidized bed furance

3. Other

4. Energy recovery

II. APPROACHES

A. Solid waste technology

1. Past attempts

2. Evolved systems

3. Experience

a. Germany

b. France

c. America

B. Sludge incineraters - RDF fuel

1. Fluidized bed

2. Multiple hearth

3. Experience

a. Franklin

b. Concord

III. CONCLUSIONS

A. Available technology

1. Solid waste-fired steam generators

2. Being replicated

B. Developmental technology

1. Incineration with RDF

2. Pyrolysis with RDF

3. Autothermic pyrolysis

C. Integrated facilities - optimal option?

SLUDGE DISPOSAL METHODS

TECHNIQUE	PERCENTAGE
• LANDFILL	25
• LAND APPLICATION	25
• OCEAN DUMPING	15
• INCINERATION	35

APPROACHES TO THERMAL CO-DISPOSAL

- SOLID WASTE TECHNOLOGY
  - MASS BURNING SYSTEMS
  - REFUSE FIRED STEAM GENERATORS
- SLUDGE INCINERATOR TECHNOLOGY
  - RDF AS A FUEL
  - MULTIPLE HEARTH/FLUIDIZED BED FURNACES

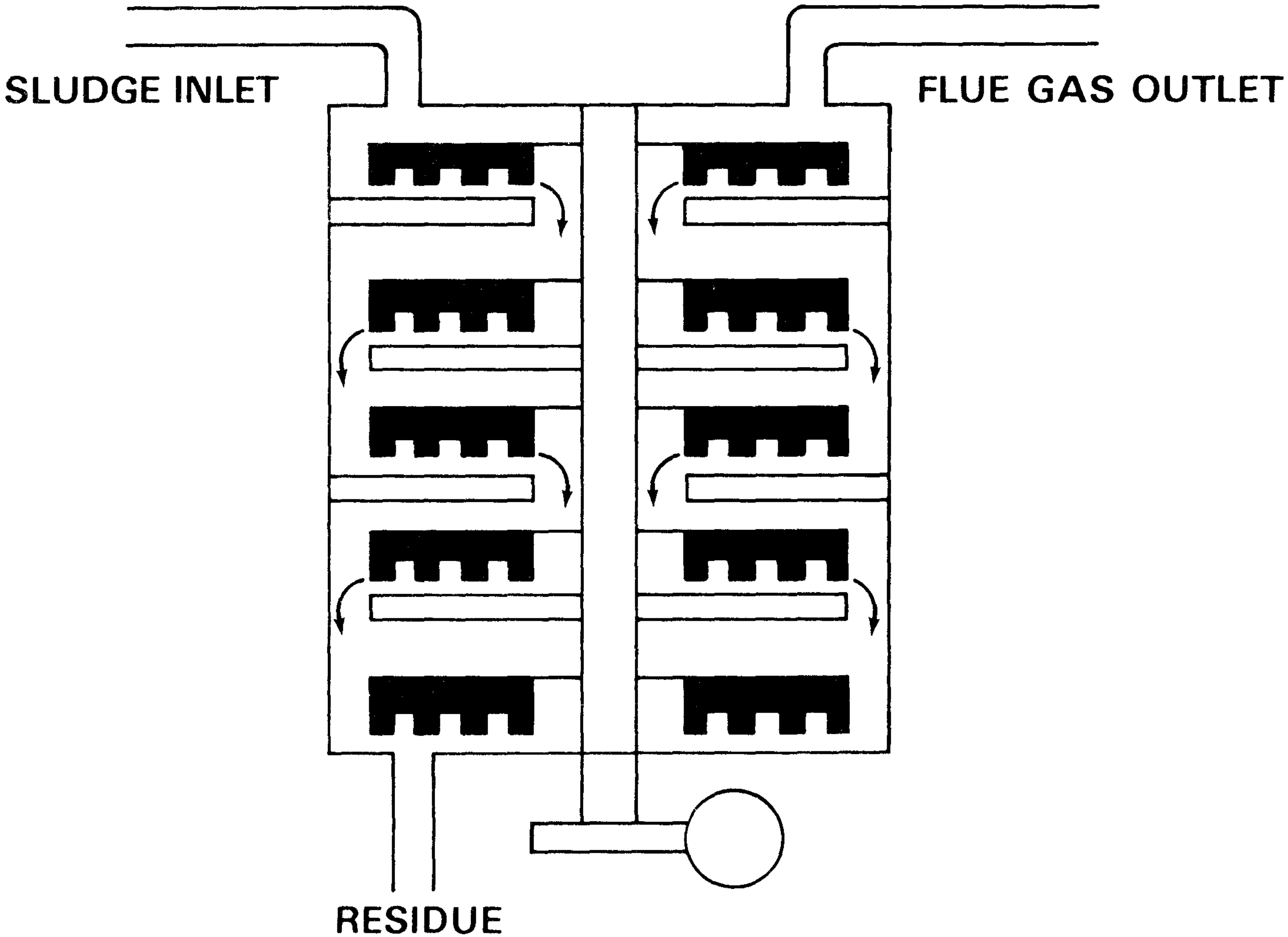
SOLID WASTE TECHNOLOGY EXPERIENCE

SLUDGE DRYING METHOD	
FLUE GAS	STEAM
ANSONIA, CT.	DIEPPE, FR.
HOLYOKE, MA.	BRIVE, FR.
ESSEN, F.R.G.	DEAUVILLE, FR.
KREFELD, F.R.G.	GLEN COVE, N.Y.
INGOLSTADT, F.R.G.	
HORSENS, DEN.	

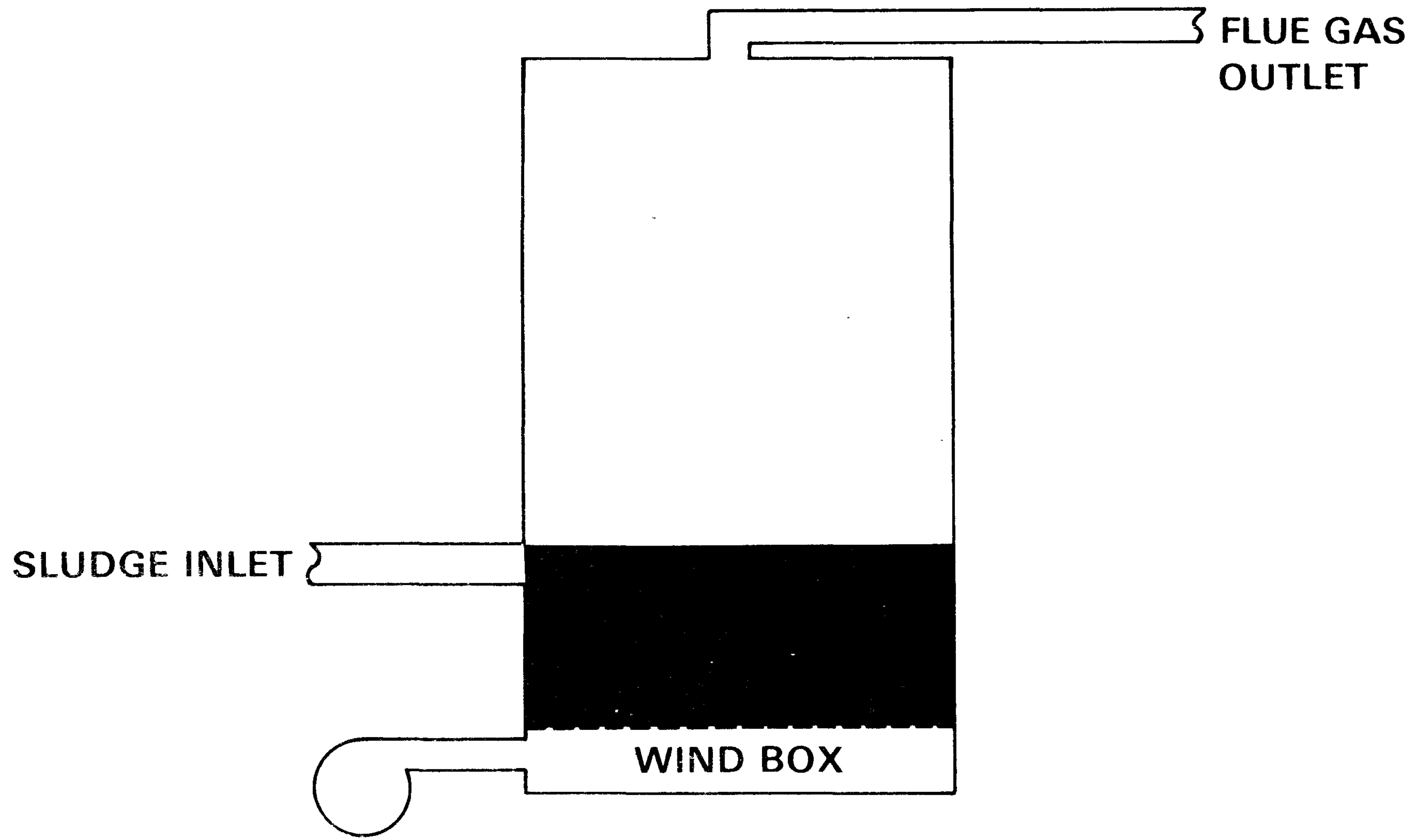
SLUDGE INCINERATION TECHNOLOGY FIRED WITH RDF

- FRANKLIN, OHIO
- CONCORD, CALIF.
- DULUTH, MINN.
- MEMPHIS, TENN.

MULTIPLE HEARTH FURNACE



FLUIDIZED BED FURNACE



CONCLUSIONS

- AVAILABLE TECHNOLOGY
- DEVELOPMENTAL TECHNOLOGY
- INTEGRATED FACILITIES

Methane Recovery

METHANE GAS RECOVERY FROM LANDFILLS

I. BIOLOGICAL DECOMPOSITION OF SOLID WASTE IN LANDFILLS PRODUCES METHANE GAS

II. MIGRATION/BUILD-UP OF METHANE GAS CAN BE HAZARDOUS

<u>Solutions:</u>

A. Install impermeable barriers

B. Counterpumping

1. Flare gas
2. Recover gas

III. TYPICAL LANDFILL METHANE GAS COMPOSITION

	%
Methane (CH_4)	50
Carbon dioxide (CO_2)	48
Hydrogen (H_2), Oxygen (O_2), Nitrogen (N_2), misc.	2
	100%

IV. POTENTIAL UTILIZATION OF METHANE GAS FROM LANDFILLS

		BTU/SCF
A.	Onsite use (raw gas)	450-500
B.	Offsite use (raw gas) in small industrial boiler	450-500
C.	Offsite use in industrial boiler, in utility pipe line (after CO_2, H_2O removal)	750-900

D. Onsite generation of electric power through use of landfill gas as fuel

V. METHANE RECOVERY OPERATIONS AT LANDFILLS

A. Palos Verdes, CA

B. Mountain View, CA

C. Sheldon-Arleta, CA

D. Azusa-Western, CA

VI. ECONOMIC FACTORS

A. Quantity of landfill gas available

B. BTU content of gas

C. Cost per BTU of local natural gas and/or alternative fuels

D. Capital cost for landfill gas processing equipment and facilities

Waste Exchange and Oil Recovery

WASTE EXCHANGE

I. INTRODUCTION

A. What is a waste exchange?

B. How does a waste exchange work?

II. DEFINITIONS

A. Information exchange

B. Materials exchange

III. HISTORY

A. Foreign

B. Domestic

IV. SUCCESS

A. Past; present; future

B. Most likely to succeed

C. Potential partners

D. Deterrents

V. SUMMARY

Waste Oil Recovery

I. Waste Oil Resources.

A. Approximately 1.2 billion gallons of waste oil are generated each year in the United States.

B. Automotive lubricating oil accounts for the majority of the waste oils generated.

II. Waste Oil Destinations.

A. Energy recovery accounts for over 50% of the waste oil reuse today.

B. Approximately 10% of the waste oil is rerefined.

C. 20% is used as a dust suppressant or asphalt extender.

D. As much as 20% is dumped or incinerated without any recovery occuring.

III. Environmental/Resource Conservation/Energy Conservation.

A. Rerefining offers the most conservation benefits.

B. Energy recovery requires complete "cleaning" of the oil or adequate pollution control technology to protect against air pollution problems.

IV. Federal Actions.

A. Resource Conservation and Recovery Act.

1. Hazardous Waste Management.

2. Procurement.

B. Energy Policy and Conservation Act - Labeling Containers of Oil.

V. Examples of State and Local Activities.

A. Utah.
B. Maryland.
C. San Diego, California.

VI. What You Can Do.

A. Procurement of rerefined lubricating oil.
B. Selling of crankcase drainings to rerefiners.
C. Collection of waste oil by lube oil sellers.
D. Incentives for locating rerefiners in your region.

INFORMATION EXCHANGES IN THE UNITED STATES

March 1978

California

California Waste Exchange
California State Health Department
Vector and Waste Management
2151 Berkeley Way
Berkeley, CA 94704
(415)843-7900 Ex. 434

Illinois

Environmental Clearinghouse Organization
Illinois Liquid Waste Haulers Association
3426 Maple Lane
Hazelcrest, IL 60424
(312)335-0754

Iowa

Iowa Industrial Waste Information Exchange
CIRAS, Building E
Iowa State University
Ames, Iowa 50010
(515)294-3420

Georgia

Georgia Waste Exchange
Georgia Business and Industry Association
181 Washington Street, S.W.
Atlanta, GA 30303
(404)659-4444

Minnesota

Minnesota Waste Exchange
Minnesota Association of Commerce and Industry
200 Hanover
480 Cedar Street
St. Paul, Minnesota 55101
(612)227-9591

Missouri

St. Louis Industrial Waste Exchange
St. Louis Regional Commerce and Growth Association
10 Broadway
St. Louis, MO 63102
(314)231-5555

New Jersey

New Jersey State Waste Exchange
New Jersey State Chamber of Commerce
5 Commerce Street
Newark, N.J. 07102
(201)623-7070

New York

Industrial Material Bulletin
EnKarn Corporation
P.O. Box 590
Albany, N.Y. 12201
(518)436-9684

Syracuse Waste Exchange
Allied Chemical
P.O. Box 6
Solvay, N.Y. 13209
(315)487-4198

Ohio

Industrial Waste Information Exchange
Columbus Industrial Association
1515 West Lane Avenue
Columbus, OH 43221
(614)486-6741

Oregon

Portland Recycling Team
1801 N.W. Irving
Portland, OR 97209
(503)228-5375

Tennessee

Tennessee Waste Swap
Tennessee Department of Public Health
Division of Solid Waste Management
230 Capitol Hill Building
Nashville, TN 37219
(615)741-3424

Texas

Houston Waste Exchange
Houston Chamber of Commerce
1100 Milam Building - 25th Floor
Houston, TX 77002
(713)651-1313

Washington

Western Environmental Trade Association
Park Place Suite 314
1200 6th Avenue
Kent, WA 98101
(206)623-5235

MATERIAL EXCHANGES IN THE UNITED STATES

March 1978

California

Zero Waste Systems
2928 Popular Street
Oakland, CA 94608
(415)893-8257

Massachusetts

National Resources Recycling Exchange
286 Congress Street
Boston, Mass. 02210
(617)482-2727

New York

Union Carbide
Surplus Products Group
Investment Recovery Department
270 Park Avenue
New York, N.Y. 10017
(212)551-2345

Health, Safety and Environmental Considerations

HEALTH, SAFETY AND ENVIRONMENTAL CONSIDERATIONS

I. INTRODUCTION

A. Any waste processing facility will have environmental impacts

B. It is possible to satisfy all environmental requirements

C. Don't try to cut corners

D. Topics to discuss

1. Air emissions

2. Bacteria and virus

3. Fires and explosions

4. Noise

5. Water effluents

6. Solid residuals

II. AIR EMISSIONS

A. The technology is available to control emissions to all applicable standards

B. New ESP's on waterwall combustion units are meeting new Federal and State regulations

C. There have been problems too

D. It's cheaper to do it right the first time

E. St. Louis results

1. No increase at design load of boiler

2. Two-fold increase at "normal" operating load

F. New attainment of National Ambient Air Quality Standards

1. Conflicting objectives

2. Must offset new sources by eliminating existing sources

G. Dust

1. Plant interior

2. Plant exterior

3. Controlling dust - can be costly

III. BACTERIA

A. Associated with high dust levels

B. High counts measured in St. Louis

1. Not in worker areas

2. No dust control

3. Sampled within ducts

C. Controlling bacteria

IV. FIRES AND EXPLOSIONS

A. Two types of explosions

1. Deflagrations

2. Detonations

3. Control of explosions

V. NOISE

A. At the property line

B. Within the plant

VI. WATER EFFLUENTS

A. No unique problems

B. Conventional solutions available

VII. SOLID RESIDUALS

A. No system recycles everything

B. Still must have a sanitary landfill

C. Some residue can be recycled

Economic Considerations

COSTS

I. TWO COMMON QUESTIONS

- A. Which system is cheapest?
- B. How much will it cost?
  - Questions cannot be answered as stated because:
    - o Each situation is different
    - o There is no universally cheapest system
    - o Cost data, without details, are meaningless

II. WHICH SYSTEM IS CHEAPEST?

No answer - RDF vs. Waterwall combustion example

III. HOW MUCH WILL IT COST?

- A. Which cost elements are included?
  1. Capital cost elements - examples of relative magnitude
  2. O & M cost elements - examples of relative magnitude
- B. Specific features of project
  1. Financing method
  2. Design features
  3. Markets
- C. Accuracy of estimates
  1. Level of technology development
  2. Level of system design

IV. SUGGESTIONS FOR EVALUATING COSTS

V. KEEP COSTS IN PERSPECTIVE

HOW MUCH WILL IT COST?

- Which cost elements are included

- Specific features of implementation
    - Financing method
    - Design features
    - Markets

- Accuracy of estimate
    - Level of technology development
    - Level of system design

CAPITAL COST ELEMENTS

	(000)	%
Construction	$26,400	57
Land and site preparation	2,100	4.5
Contingency	2,800	6.0
Engineering	4,000	8.6
Start-up	5,200	11
Interest during construction	4,500	9.7
Financing, legal, spare parts, construction management	1,500	3.2
Debt reserve	-	-
	$46,500	100

O & M COST ELEMENTS

	(000)	%
Labor (including overhead)	$2,000	35
Utilities	1,100	19
Consummables (supplies, parts)	1,100	19
Replacement Equipment	-	-
Residue Disposal	530	9.3
Insurance, Taxes, Licenses	160	2.8
Management Fees	790	14
Bond Reserve Fill-up	-	-
	$5,680	100

COST VS. DESIGN FEATURES

Reliability

Utilization

System Size

Products

Health and Safety Considerations

Site Conditions

Architectural Treatment

COST VS FINANCING

INTEREST RATE	6%	8%
AMORTIZATION		
15 YR	$10.00	$11.25
25 YR	$7.50	$9.00

ASSUMES:

$50 MILLION CAPITAL COST
2000 TPD, 260 DPY

ACCURACY
VS
LEVEL OF SYSTEM DESIGN

DESIGN LEVEL	ACCURACY DEVIATION
FEASIBILITY STUDY	40—50%
PRELIMINARY DESIGN	20—40%
FINAL DESIGN	10—20%

SUGGESTIONS FOR EVALUATING COSTS

- Published costs will not apply to your situation.
- Understand the limitations of cost estimates -- ask for ranges and accuracy limits.
- Ask for costs to be broken down in detail -- compare apples with apples and make sure all apples are accounted for.
- Be wary of cost estimates for unproven technologies.
- Acquire proper expertise to help analyze costs.

Contracts, Risks and Financing

CONTRACTS, RISKS, AND FINANCING

I. INTRODUCTION

A. The implementation process

B. Outline of talk

1. Managing implementation

2. Plant procurement

3. Risk management

4. Financing

5. Developing the RFP

II. MANAGING IMPLEMENTATION

A. Elements of good management

B. Minimize conflicts of interest

III. PLANT PROCUREMENT

A. Procurement strategy

B. Procurement approaches

C. Which procurement approach is best?

D. Why it is important to select one procurement approach and stick with it

IV. RISK MANAGEMENT

A. Elements of risk management

1. Identify the sources

2. Identify the consequences

3. Identify the probabilities

4. Reduce the risk

B. Categories of risk

C. Ways to reduce risk

D. Who will accept the responsibility?

V. FINANCING

A. Options to consider

B. Making a project financeable

VI. DEVELOPING THE RFP

A. What the RFP should include

1. Technical requirements

2. Management requirements

3. Financing requirements

4. Environmental requirements

5. Contractual requirements

B. Alternative approaches

C. Selection and negotiation

D. Resource recovery categories

E. Ways of reducing risks

F. Who will accept risks

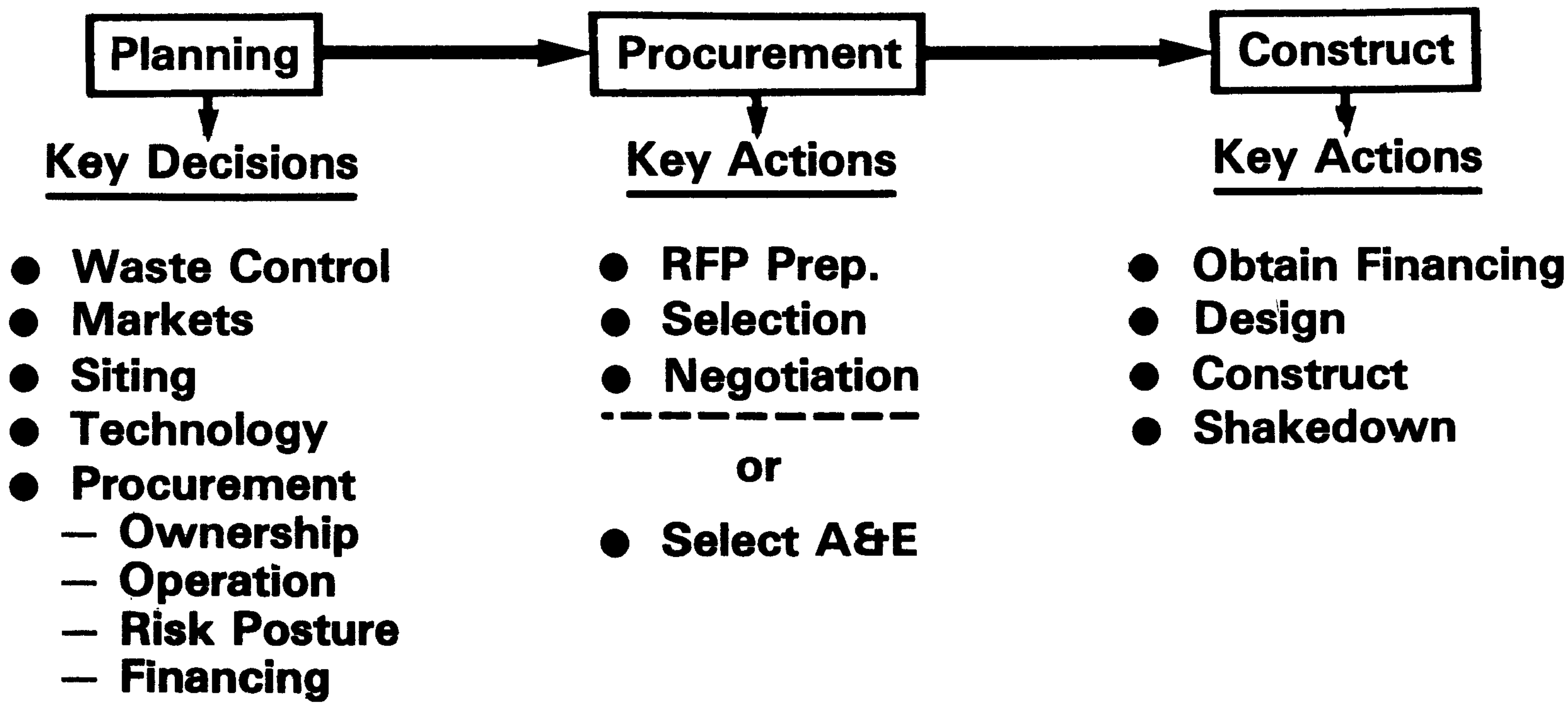
    1. How many involved, who has control

    2. Who will accept risks

G. Cost of accepting risks

H. Conclusion

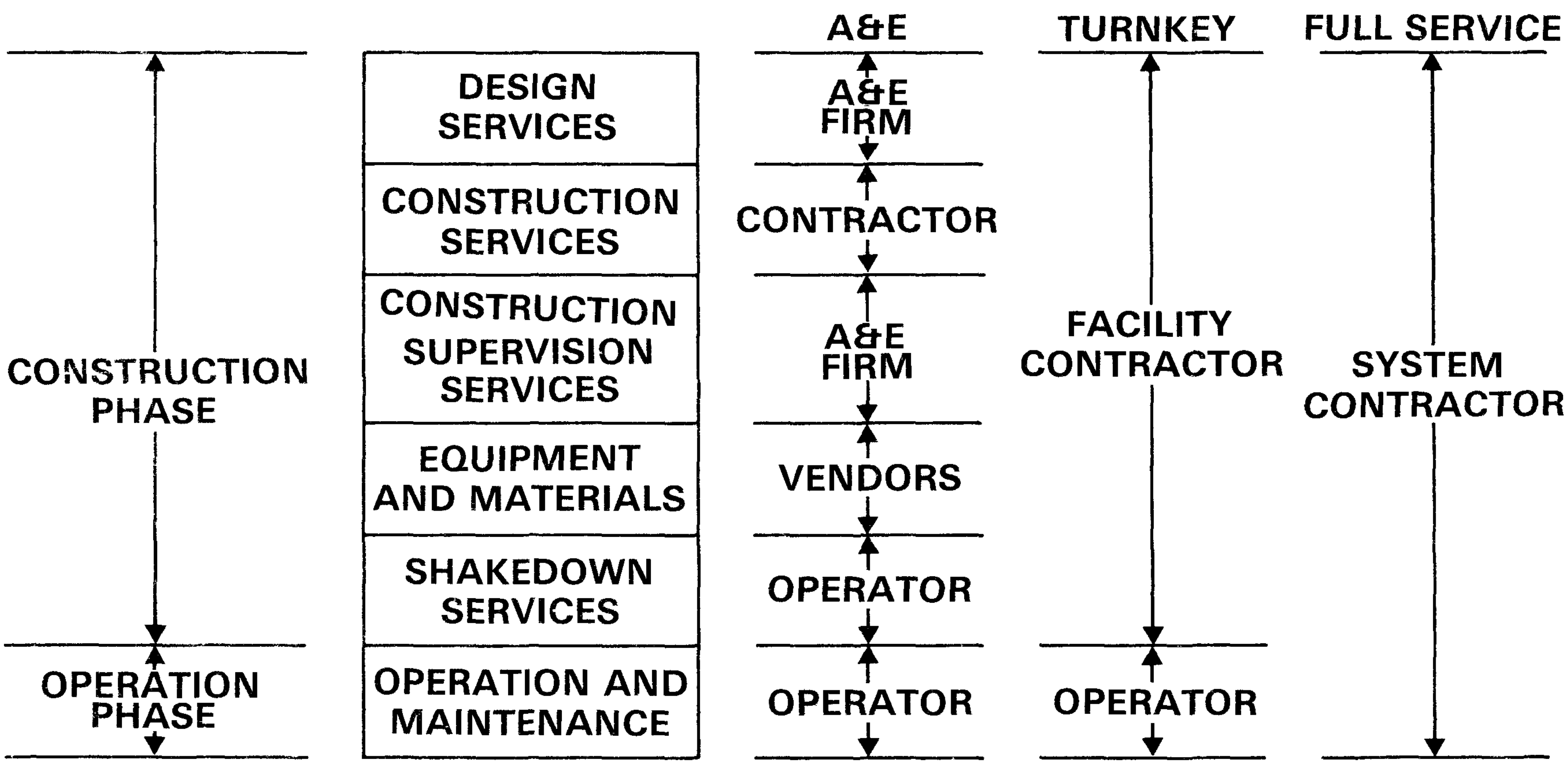
The Implementation Process



ELEMENTS OF GOOD MANAGEMENT

- COMMITTMENT TO THE PROJECT
- STRONG LEADER/GOOD STAFF
- APPROPRIATE USE OF CONSULTANTS
- COORDINATION WITH OTHER INTERESTED GROUPS
- CAREFUL PLANNING, SCHEDULING, REVIEW

FACILITY CONSTRUCTION AND OPERATION PROCUREMENT APPROACHES



EXAMPLES OF RISK

CATEGORY	EVENT
• FACILITY	
— CONSTRUCTION	INCREASE IN REQUIRED INVESTMENT
— OPERATION	UNRELIABLE PERFORMANCE
• WASTE STREAM	CHANGE IN TONNAGE
• MARKETS	CANCELLATION OF CONTRACT
• CATASTROPHIC EVENTS	STORMS, SABOTAGE, STRIKES

WAYS TO REDUCE RISK

CATEGORY	STRATEGY
• FACILITY	LESS COMPLEX TECHNOLOGY MORE PROVEN TECHNOLOGY EXPERIENCED DESIGNER BUILT-IN RELIABILITY EXPERIENCED OPERATOR
• WASTE STREAM	CONTROL OF WASTE
• MARKET	EARLY SURVEY OF MARKETS MORE ACCEPTABLE PRODUCT LONG TERM CONTRACT
• CATASTROPHIC EVENTS	DESIGN INSURANCE

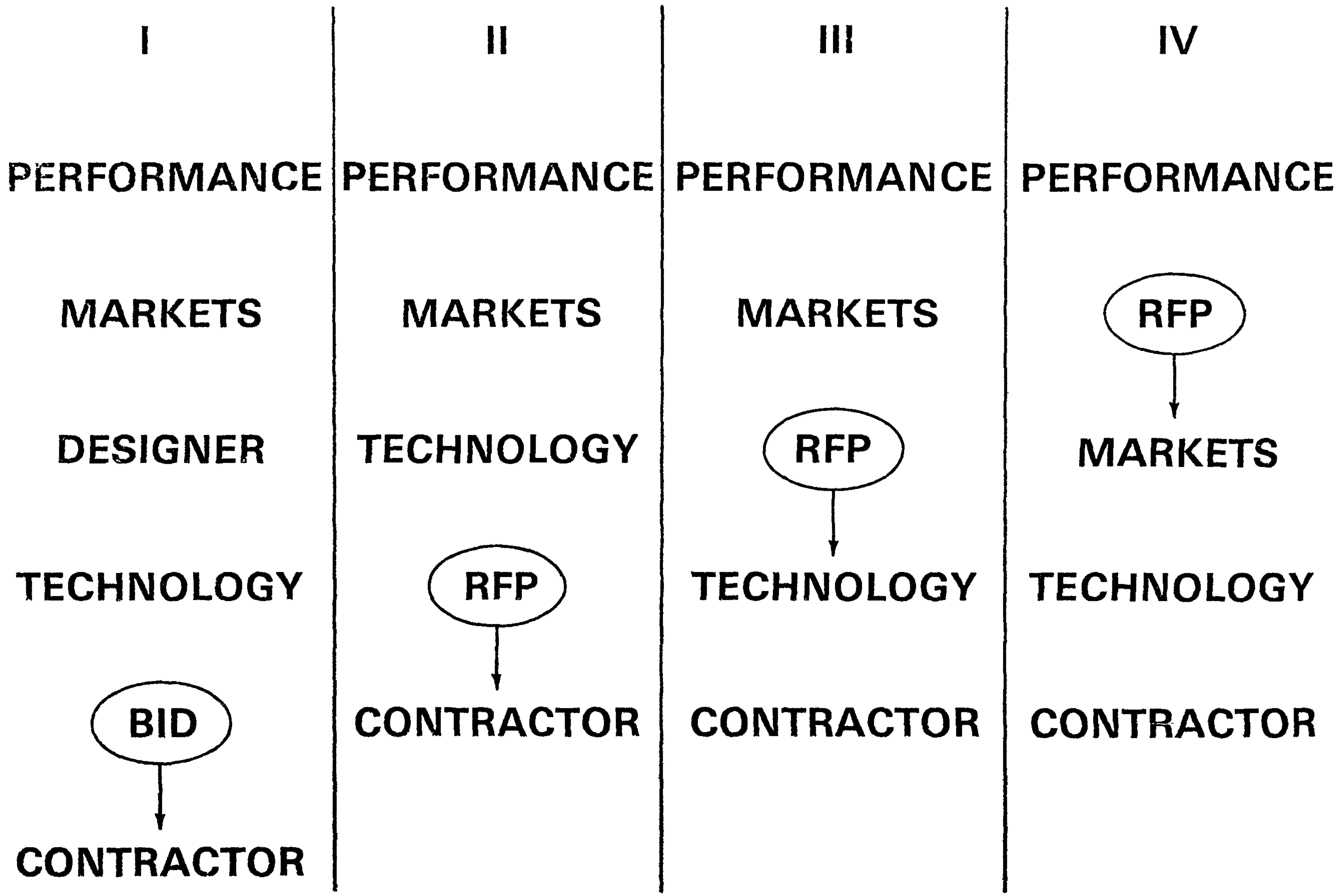
WILL A CONTRACTOR TAKE THE RISK?

CATEGORY	PROCUREMENT APPROACH		
	A&E	TURNKEY	FULL SERVICE
• FACILITY			
— CONSTRUCTION	NO	YES	YES
— OEPRATION	NO	NO	YES
• WASTE STREAM	NO	NO	NO
• MARKET	NO	NO	YES
• CATASTROPHIC EVENTS	NO	NO	SHARE

FINANCING AND PROCUREMENT APPROACHES

	A&E	TURNKEY	FULL SERVICE
GO BONDS	AMES CHICAGO		LANE COUNTY
REVENUE BONDS	HARRISBURG NASHVILLE		SAUGUS BRIDGEPORT HEMPSTEAD
OTHER	NORFOLK BALTIMORE CO. MONROE CO.	BALTIMORE	MILWAUKEE NEW ORLEANS DADE COUNTY

SELECTION ALTERNATIVE STRATEGIES



Reading List

FURTHER READING

ON

RESOURCE RECOVERY AND WASTE REDUCTION

The following information is a compilation of published and unpublished resource recovery and waste reduction information. Most have recently been developed by the U.S. Environmental Protection Agency. Unless otherwise stated, for copies, please write to:

Solid Waste Information
U. S. Environmental Protection Agency
Cincinnati, Ohio 45268
(Order blank attached)

I. GENERAL INFORMATION

390+ DECISION-MAKERS'S GUIDE IN SOLID WASTE MANAGEMENT. Environmental Protection Agency, 1976. 158 p.
A series of two to five-page discussions of approximately thirty solid waste management topics including resource recovery and separate collection.

448 RESOURCE RECOVERY AND WASTE REDUCTION: THIRD REPORT TO CONGRESS. Environmental Protection Agency, 1975. 96 p.
Examines policy issues, reviews technological progress, summarizes city and States activities, and reviews EPA studies and investigations for 1974.

600 RESOURCE RECOVERY AND WASTE REDUCTION: FOURTH REPORT TO CONGRESS. Environmental Protection Agency. January 1977. (In preparation.)
Examines policy issues, updates solid waste generation and summarizes city, State and Federal Government activities in R&D, Guidelines and implementation of resource recovery and waste reduction programs during 1975-76.

344 RECYCLING AND THE CONSUMER. Environmental Protection Agency, 1974. 12 p.
An introduction to recycling and waste reduction and what the individual can do to promote them.

443 COMPARATIVE ESTIMATES OF POST-CONSUMER SOLID WASTE. Smith, Frank. 1975. 18 p.
Presents a comparison of the quantity and composition of municipal solid waste.

+The number at left is the number for ordering publications from the above address.

432 NATIONWIDE SURVEY OF WASTE REDUCTION AND RESOURCE RECOVERY ACTIVITIES. McEwen, L. 1977.
A summary of progress in resource recovery projects throughout the United States. Updated periodically.

BASELINE FORECASTS OF RESOURCE RECOVERY. Midwest Research Institute. March 1975. 376 p. Distributed by the National Technical Information Service, U. S. Department of Commerce, Springfield, Va. 22151. Publication No. PB-245 924.
Forecasts to 1990 the quantity of waste generation, the recovery of resources from municipal solid waste, the recovery of specific materials in solid waste, the total recoverable quantity of seven specific materials and the sources of generation for residential, commercial and industrial wastes.

528 DEMONSTRATING RESOURCE RECOVERY. EPA Staff. Reprinted from Waste Age, June 1976.
A summary of EPA's resource recovery demonstration projects. Discusses problem encountered and gives current status.

505 WASTE REDUCTION AND RESOURCE RECOVERY: THERE IS ROOM FOR BOTH. Humber, N. Reprinted from Waste Age, November 1975.
Defines terms and explains how resource recovery, source separation and waste reduction can work together.

THE IMPACT OF SOURCE SEPARATION AND WASTE REDUCTION ON THE ECONOMICS OF RESOURCE RECOVERY FACILITIES. Skinner, J. H. Presented at the Fifth National Congress on Waste Management Technology and Resource and Energy Recovery sponsored by the National Solid Waste Management Association. Dallas, Texas, December 9, 1976. Distributed by the Resource Recovery Division (AW-463), Office of Solid Waste, U. S. Environmental Protection Agency, Washington, D. C. 20460.

II. WASTE REDUCTION

487 BEVERAGE CONTAINERS: THE VERMONT EXPERIENCE. Loube, M. 1975. 16 p.
Analyzes the impact of the Vermont beverage container legislation.

462 QUESTIONS AND ANSWERS ON RETURNABLE BEVERAGE CONTAINERS FOR BEER AND SOFT DRINKS. Environmental Protection Agency, June 1975. 9 p.
Gives answers to frequently asked questions on deposit legislation and its impacts.

463 SOLID WASTE MANAGEMENT-GUIDELINES FOR BEVERAGE CONTAINERS.
Federal Register, September 20, 1976. (40 CFR Part 244.)
Guidelines for implementing a deposit system on beverage containers sold on Federal facilities.

572 UNTRASHING YOSEMITE PARK. Pierce, C. Reprinted from EPA Journal, October 1976.
Review of the Yosemite National Park's experience with returnable beverage containers.

531 PRICE SURVEY OF BEVERAGES IN REFILLABLE AND NONREFILLABLE CONTAINERS.
Peterson, C. October 1976. 2-pg. press release.
Summary of price comparison survey of beverages in refillable and nonrefillable containers.

III. MARKETS

518 MARKET LOCATIONS FOR RECOVERED MATERIALS. Howard, S. 1976. 88 P.
Contains lists of actual or potential users of recycled paper, steel, glass, and aluminum. Certain key data are presented when available for each facility, including whether they use recycled materials and their yearly capacity.

OVERCOMING INSTITUTIONAL BARRIERS TO SOLID WASTE UTILIZATION AS AN ENERGY SOURCE. Prepared for Federal Energy Administration by Gordian Associates Inc., 1976. Distributed by the National Technical Information Service, U. S. Dept. of Commerce, Springfield, Va. 22151. Will be available in July 1977.

343 THE NATIONAL BUYER'S GUIDE TO RECYCLED PAPER. Environmental Educators, Inc. October 1973. 208 p.
Directory of paper companies and their distributors who manufacture products containing recycled paper. Products and recycled contents are listed.

USE OF REFUSE-DERIVED SOLID FUEL IN ELECTRIC UTILITY BOILERS.
Lingle, S. A., and J. R. Holloway. Presented at the Fifth National Congress on Waste Management Technology and Resource Recovery sponsored by the National Solid Waste Management Association. Dallas, Texas, December 9, 1976. Distributed by the Resource Recovery Division (AW-463), Office of Solid Waste, U. S. Environmental Protection Agency, Washington, D. C. 20460.
Discusses the status of electricity utility use of solid waste as a supplemental boiler fuel, the concerns of the utilities and a method for estimating value of solid waste as a fuel.

IV. SOURCE SEPARATION AND PAPER RECYCLING

486 RESIDENTIAL PAPER RECOVERY: A MUNICIPAL IMPLEMENTATION GUIDE. Hansen, P. 1975. 26 p.
Discusses municipal separate collection in terms of methods of collection, public vs. private collection, success factors, pilot vs. full-scale programs, and mandatory vs. voluntary separation.

553 RESIDENTIAL PAPER RECOVERY: A COMMUNITY ACTION PLAN. National Center for Resource Recovery, Inc. 1976.
Describes how to conduct a public education campaign implementing a community source separation program. This is a companion document to #486.

400 A NEW LOOK AT THE ECONOMICS OF SEPARATE REFUSE COLLECTION. SCS Engineers and EPA Staff. Reprinted from Waste Age, May/June 1974.
Discusses the economic implications of separate refuse collection.

ANALYSIS OF SOURCE SEPARATE COLLECTION OF RECYCLABLE SOLID WASTE. (2 vols.) SCS Engineers. 1974. Distributed by the National Technical Information Service, U.S. Dept. of Commerce, Springfield, Va. 22151. Will be available in July 1977.
Final report of detailed case studies of separate collection and recycling centers. Discusses economics, equipment, public response and other influencing factors.

446 WHAT YOU CAN DO TO RECYCLE MORE PAPER. Environmental Protection Agency. 1975. 12 p.
Guide for citizens interested in ways to recycle paper.

473 MATERIALS RECOVERY: SOLID WASTE MANAGEMENT GUIDELINES FOR SOURCE SEPARATION. Federal Register, April 23, 1976. (40 CFR Part 246.)
Guidelines for source separation in Federal facilities.

A NEW LOOK AT RECYCLING WASTE PAPER. Citizens' Advisory Committee on Environmental Quality. 1976. 88 p. Distributed by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402. No. 040-000-00369-0. $1.55/copy, 25% discount on orders of 100 or more.
Report on a conference held May 11, 1976, sponsored by NCRR, involving key people knowledgeable on the subject of the recycled paper problem.

WASTEPAPER RECYCLING. 12 p.
WASTEPAPER RECYCLING FOR COMMERCE AND INDUSTRY. 12 p.
WASTEPAPER RECYCLING FOR CIVIC AND CHARITABLE GROUPS. 12 p.
OFFICE PAPER RECYCLING. 12 p.
Distributed by the American Paper Institute, Paper Stock Conservation Committee, 260 Madison Avenue, New York, N. Y. 10016.
Four brief brochures outlining considerations for starting municipal, civic, office or industrial paper collection programs.

510 DEMONSTRATING MULTIMATERIAL SOURCE SEPARATION IN SOMERVILLE AND MARBLEHEAD, MASSACHUSETTS. Hansen, P. and Resource Planning Associates. Reprinted from Waste Age, Feb. 1976. Describes two demonstration projects, funded in part by EPA, where source separated materials are collected for recycling.

EVALUATION OF A COMPARTMENTALIZED REFUSE COLLECTION VEHICLE FOR SEPARATE NEWSPAPER COLLECTION. SCS Engineers. 1976. 94 p. Distributed by the National Technical Information Service, U. S. Dept. of Commerce, Springfield, Va. 22151. Publication No. PB-257 969.
Presents information on the economic viability of a compartmentalized refuse collection vehicle for separate newspaper collection.

575 RESOURCE RECOVERY THROUGH MULTIMATERIAL SOURCE SEPARATION. Hansen, P. Reprinted from Waste Age, October 1976.
Review of Somerville and Marblehead, Mass., source separation demonstrations.

551 SOURCE SEPARATION: THE COMMUNITY AWARENESS PROGRAM. Resource Planning Associates. 1976. 88 p.
Describes the public education campaign conducted to kick-off the source separation programs in Somerville and Marblehead, Mass.

V. ECONOMICS

482 RESOURCE RECOVERY PLANT COST ESTIMATES. A COMPARATIVE EVALUATION OF FOUR RECENT DRY-SHREDDING DESIGNS. Smith, Frank. October 1975. 20 p.
A standardized evaluation of cost estimates for four dry-shredding facilities.

ENGINEERING AND ECONOMIC ANALYSIS OF WASTE TO ENERGY SYSTEMS. Ralph M. Parsons Co., 1977. Distributed by the National Technical Information Service, U. S. Dept. of Commerce, Springfield, Va. 22151.
An evaluation of existing resource recovery systems.
EPA Contract No. 68-02-2101.

VI. MECHANICAL MATERIALS RECOVERY

558 COLOR SORTING WASTE GLASS AT FRANKLIN, OHIO. Garbe, Y. M. Reprinted from Waste Age, September 1976. An evaluation of the waste glass color sorting subsystem at the Franklin, Ohio, resource recovery demonstration project.

A TECHNICAL, ENVIRONMENTAL AND ECONOMIC EVALUATION OF THE GLASS RECOVERY PLANT AT FRANKLIN, OHIO. Systems Technology Corporation. 1977. Distributed by the Resource Recovery Division (AW-463), Office of Solid Waste, U. S. Environmental Protection Agency, Washington, D. C. 20460.

VII. WATERWALL COMBUSTION

548 CAN NASHVILLE'S STORY BE PLACED IN PERSPECTIVE? McEwen, L. B,. and S. J. Levy. Reprinted from Solid Waste Management, August 1976. An evaluation of the technical problems encountered by the Nashville Thermal Transfer Corporation's waterwall incineration facility.

537 AIR EMISSIONS FROM SOLID WASTE-FIRED STEAM GENERATORS IN THE U. S. Sussman, D. Reprinted from Waste Age, July 1976. A list with discussion compiled from Various sources of particulate emission data from 100 percent solid waste-fired steam generators.

VIII. SOLID WASTE AS A SUPPLEMENTARY FUEL FOR POWER PLANTS

538 EPA RESOURCE RECOVERY DEMONSTRATION: SUMMARY OF AIR EMISSIONS ANALYSES. Holloway, J. R. Reprinted from Waste Age, August 1976. Summary of St. Louis RDF project particulate, and bacteria and virus emissions testing at processing plant, and particulate and gaseous emissions at power plant.

ST. LOUIS/UNION ELECTRIC REFUSE FIRING DEMONSTRATION AIR POLLUTION TEST REPORT. Midwest Research Institute. August 1974. Distributed by the National Technical Information Service, U. S. Dept. of Commerce, Springfield, Va. 22151. Publication No. PB-237 630. The result of EPA's air emission test conducted in December 1973 as part of the St. Louis energy recovery demonstration.

ST. LOUIS DEMONSTRATION PROJECT AIR EMISSION TESTS: EVALUATION OF UNREGULATED PARTICULATES, VAPORS, AND GASES IN POWER PLANT FLUE GASES. Holloway, J. R., and S. J. Levy. Distributed by the Resource Recovery Division (AW-463), Office of Solid Waste, U. S. Environmental Protection Agency, Washington, D. C. 20460. A summary of air emissions tests for unregulated substances.

IX. PYROLYSIS

537 BALTIMORE PYROLYSIS PLANT STATUS REPORT. Sussman, D. Reprinted from Waste Age, July 1976.
A status report on the Baltimore demonstration project covering the period of January 1-June 30, 1976.

DEMONSTRATION OF PYROLYSIS AND MATERIALS RECOVERY IN SAN DIEGO, CALIFORNIA. Garbe, U. M. Reprinted from Waste Age, December 1976. Distributed by the Resource Recovery Division (AW-463), Office of Solid Waste. U. S. EPA, Washington, D. C. 20460.

REVIEW OF THE STATUS OF PYROLYSIS AS A MEANS OF RECOVERING ENERGY FROM MUNICIPAL SOLID WASTE. Levy, S. J. Presented at the Third Annual U. S. - Japan Conference on Solid Waste Management May 12-14, 1976. 29 p. Distributed by the Resource Recovery Division (AW-463), Office of Solid Waste, U. S. Environmental Protection Agency, Washington, D. C. 20460.
A technical review of four pyrolysis systems currently being marketed in the United States.

X. IMPLEMENTATION

RESOURCE RECOVERY PLANT IMPLEMENTATION: GUIDES FOR MUNICIPAL OFFICIALS.
A series of publications covering all aspects of the planning and procurement process for resource recovery.

533 PLANNING AND OVERVIEW. Lowe, R. A., and A. Shilepsky. 1976. 34 p.
Discusses three major steps--study, selection, and procurement--leading to implementation of resource recovery with emphasis on significant issues and problems.

550 TECHNOLOGIES. Levy, S. J. and H. G. Rigo. 1976. 81 p.
A review of various technologies available to recover energy and resources from municipal solid waste.

496 RISKS AND CONTRACTS. Randol, R. 1976. 52 p.
Examines risks in resource recovery and possible risk allocations. Case studies of contractual arrangements in Milwaukee, Nashville, and Bridgeport.

499 MARKETS. Garbe Y. M., and S. J. Levy. 1976. 47 p.
Discusses the markets for energy and material products recovered from municipal solid waste.

493 ACCOUNTING FORMAT. Sussman, D. 1976. 17 p.
Presents a standardized accounting procedure for resource recovery facilities.

471 FINANCING. Randol, R. 1975. 20 p.
Discusses alternatives for financing resource recovery facilities.

495 PROCUREMENT. Shilepsky, A. 1976. 66 p.
Discusses the process of preparing a Request for Proposals and evaluating the responses.

470 FURTHER ASSISTANCE. Hawkins, D. 1975. 29 p.
Provides sources for information on resource recovery.

567 RESOURCE RECOVERY PLANNING: AN OVERVIEW OF THE IMPLEMENTATION PROCESS. National League of Cities. 1976.
A brief discussion of issues to assist local officials in preparing and mobilizing the investigation of local resource recovery opportunities. This is a short version of # 533.

552 RESOURCE RECOVERY RFP AND CONTRACT SUMMARIES. Hawkins, D. 1976. 54 p.
Summaries of 12 requests for proposals (RFP's), 5 contracts and a letter of intent issues by cities, counties and States for resource recovery projects.

☆U.S. GOVERNMENT PRINTING OFFICE: 1978 265-356/6174 1-3

Order Blank

for

RESOURCE RECOVERY AND WASTE REDUCTION-

Current Reports

Name ______________________________

Street ____________________________

City, State, Zip ____________________

Order Nos.	Publication Titles
__________	____
__________	____
__________	____
__________	____
__________	____
__________	____

μσ1580R
SW-3004